

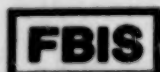
JPRS 73904

25 July 1979

# USSR Report

ELECTRONICS AND ELECTRICAL ENGINEERING

No. 49



FOREIGN BROADCAST INFORMATION SERVICE

#### NOTE

JPRS publications contain information primarily from foreign newspapers, periodicals and books, but also from news agency transmissions and broadcasts. Materials from foreign-language sources are translated; those from English-language sources are transcribed or reprinted, with the original phrasing and other characteristics retained.

Headlines, editorial reports, and material enclosed in brackets [ ] are supplied by JPRS. Processing indicators such as [Text] or [Excerpt] in the first line of each item, or following the last line of a brief, indicate how the original information was processed. Where no processing indicator is given, the information was summarized or extracted.

Unfamiliar names rendered phonetically or transliterated are enclosed in parentheses. Words or names preceded by a question mark and enclosed in parentheses were not clear in the original but have been supplied as appropriate in context. Other unattributed parenthetical notes within the body of an item originate with the source. Times within items are as given by source.

The contents of this publication in no way represent the policies, views or attitudes of the U.S. Government.

#### PROCUREMENT OF PUBLICATIONS

JPRS publications may be ordered from the National Technical Information Service (NTIS), Springfield, Virginia 22161. In ordering, it is recommended that the JPRS number, title, date and author, if applicable, of publication be cited.

Current JPRS publications are announced in Government Reports Announcements issued semimonthly by the NTIS, and are listed in the Monthly Catalog of U.S. Government Publications issued by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Indexes to this report (by keyword, author, personal names, title and series) are available through Bell & Howell, Old Mansfield Road, Wooster, Ohio, 44691.

Correspondence pertaining to matters other than procurement may be addressed to Joint Publications Research Service, 1000 North Glebe Road, Arlington, Virginia 22201.

Soviet books and journal articles displaying a copyright notice are reproduced and sold by NTIS with permission of the copyright agency of the Soviet Union. Permission for further reproduction must be obtained from copyright owner.

<b>REPORT DOCUMENTATION PAGE</b>	<b>1. REPORT NO.</b> JPRS 73904	<b>2.</b>	<b>3. Recipient's Accession No.</b> ✓
<b>4. Title and Subtitle</b> USSR REPORT: ELECTRONICS AND ELECTRICAL ENGINEERING No. 49		<b>5. Report Date</b> 25 July 1979	
<b>7. Author(s)</b>		<b>6.</b>	
<b>9. Performing Organization Name and Address</b> Joint Publications Research Service 1000 North Glebe Road Arlington, Virginia 22201		<b>8. Performing Organization Rept. No.</b>	
<b>12. Sponsoring Organization Name and Address</b>  As above		<b>10. Project/Task/Work Unit No.</b>	
		<b>11. Contract(C) or Grant(G) No.</b> (C) (G)	
		<b>13. Type of Report &amp; Period Covered</b>	
		<b>14.</b>	
<b>15. Supplementary Notes</b>			
<b>16. Abstract (Limit: 200 words)</b>  The report contains articles, abstracts and news items on electronic materials, components, and devices, on circuit theory, pulse techniques, electromagnetic wave propagation, radar, quantum electronic theory, development and devices, miniaturization techniques on electric power machinery, power transmission, and nuclear power developments.			
<b>17. Document Analysis a. Descriptors</b>  USSR Antennas Electromagnetic Spectra Network Synthesis Instruments Lasers  <b>b. Identifiers/Open-Ended Terms</b>  <b>c. COSATI Field/Group</b> 9F, 9C, 9A, 20N			
<b>18. Availability Statement</b> Unlimited Availability Sold by NTIS Springfield, Virginia 22161		<b>19. Security Class (This Report)</b> UNCLASSIFIED	<b>21. No. of Pages</b> 82
		<b>20. Security Class (This Page)</b> UNCLASSIFIED	<b>22. Price</b>

25 July 1979

# USSR REPORT

## ELECTRONICS AND ELECTRICAL ENGINEERING

No. 49

This serial publication contains articles, abstracts of articles and news items from USSR scientific and technical journals on the specific subjects reflected in the table of contents.

Photoduplications of foreign-language sources may be obtained from the Photoduplication Service, Library of Congress, Washington, D.C. 20540. Requests should provide adequate identification both as to the source and the individual article(s) desired.

CONTENTS	PAGE
<b>ELECTRONICS</b>	
Amplifiers .....	1
Antennas .....	2
Certain Aspects of Computer Hard and Soft Ware; Control, Automation, Telemechanics and Machine Planning .....	11
Certain Aspects of Television, Photography and Motion Pictures ...	16
Certain Aspects of Radioastronomy, Satellites and Space Vehicles..	21
Communications, Networks, Data Transmission and Processing .....	24
Components and circuit elements including Waveguides and Cavity Resonators .....	37
Converters, inverters, transducers .....	41
Electromagnetic Wave Propagation; Ionosphere, Troposphere Electrodynamics .....	43
Microelectronics, Integrated and Logic Circuits; Ground Circuit Theory and Information .....	53
Oscillators, Generators, Modulators .....	55
Photoelectrics, Photoelectric Effect, Photoelectric Transducers, Converters and Similar Devices .....	59
Receivers and Transmitters .....	60
Semiconductors and Dielectrics; Luminescence; Solid State; Films..	62
<b>ELECTRICAL ENGINEERING</b>	
Electrical Engineering Equipment and Machinery .....	68
Electron Tubes; Electrovacuum Technology .....	77
Power Systems .....	78

## ELECTRONICS

### Amplifiers

USSR

UDC 621.375.432

#### BROADBAND AMPLIFIER WITH A PASSBAND ABOVE 300 MHz

MOSCOW PRIBORY I TEKHNIKA EKSPERIMENTA in Russian, No 1, Jan-Feb 1979, pp 127-128 manuscript received 31 Aug 77

VOLKOV, YU.A., IL'YUSHCHENKO, I.I., KOROLEV, V.A. and PASHKIN, V.M.

Moscow Engineering and Physics Institute

[Abstract] The principal circuit and a description are presented of a small-sized broadband amplifier which uses 2T3106A and 2T354B non-cased [bezkorpusnyy] bipolar transistors. The amplifier, which measures 40 x 30 x 15 mm<sup>3</sup> has an amplification factor of 20 dB, a passband of 5 ÷ 320 MHz, and a standing-wave ratio of  $\leq 0.5$  and  $\leq 1.5$  at the input and output, respectively, and an operating range of temperature of -60 ÷ +70° C. A series connection of two and three of the sections described make it possible to increase the amplification factor to 40 and 60 dB, respectively with an insignificant deterioration of the passband. Figures 3; references 4: 3 Russian; 1 Western.

USSR

UDC 621.396.67

CONTROL SYSTEMS FOR PHASED-ARRAY ANTENNAS (REVIEW)

Kiev IZV.VUZ:RADIOELEKTRONIKA in Russian, Vol 22, No 2, 79, pp 3-17  
manuscript received 17 Jul 78

SAMOYLENKO, V.I.

[Abstract] Problems concerned with the control system of large nonplanar phased antenna arrays (including those used on radars) are reviewed, principally on the basis of non-Soviet work. In phased antenna arrays (FAR) the two basic problems fulfilled by an antenna--i.e., forming a directional diagram (DN) of the required form and orientation of it in space--are fulfilled by electronics means: by shaping of the required phase distribution on the surface of the antenna. Control of the FAR by various electron-control high-frequency devices is discussed in some detail. Figures 12; references 23: 7 Russian; 16 Western.

USSR

SHORTWAVE WEAKLY DIRECTIONAL ANTENNAS WITH HIGH BALANCING

Moscow VESTNIK SVYAZI in Russian, No 2, Feb 79, pp 30-31

BELOUSOV, S.P., Kliger, B.A., candidates in technical sciences, SVINAREV, K.M. and KORSHUN, N.U., coworkers, NIIR (Scientific-Research Institute of Radio)

[Abstract] Recently one of the radio centers of the USSR Ministry of Communications developed and introduced Type VGDSHP and VGDSHP-2U plane dipole antennas, characterized by high electrical stability and high inherent balancing. A description is presented of these antennas which have a significant advantage over antenna types VGDSH and VGDSH-2U with respect to electrical stability and balancing with the supply feeder. The new antennas assure stable reliable operation with transmitters having a power of 200--250 kW in a broad (2--2.5 fold) band without special adjustment. The technical and economic effect from the introduction of one complex of VGDSHP or VGDSHP-2U amounts to approximately 8,000 rubles. Figures 4.

USSR

UDC 621.396.67

ANALYSIS AND OPTIMIZATION OF DIRECTOR RADIATORS IN PLANE ARRAY

Kiev IZV.VUZ:RADIOELEKTRONIKA in Russian, Vol 22, No 2, 79, pp 39-41  
manuscript received 3 Jan 78; after revision, 19 May 78

INDENBOM, M.V. and FILIPPOV, V.S.

[Abstract] The simplest types of radiating elements--slot, wave guide, dipole--do not assure matching of a phased-array antenna in a wide-aperture scanning sector. The presence of a certain number of degrees of freedom in a director radiator makes it possible to consider the possibility of improving the matching of the aperture of a phased-array antenna with the corresponding selection of the geometrical parameters of director radiators. For investigation of this possibility, the characteristics are analyzed of a director radiator in a planar phased-array antenna array. Optimization of director radiators is conducted by a numerical method. The possibility is shown of matching of such a phase-array antenna in a wide sector of angles. Figures 5; references: 6 Russian.

USSR

UDC 621.396.67

#### OPTIMIZATION OF PARAMETERS OF FOCUSING ANTENNAS

Kiev IZV VUZ: RADIOELEKTRONIKA in Russian, Vol 22, No 2, 79, pp 42-46  
manuscript received 3 May 78; after revision, 5 Jun 78

BELYAYEV, B.G.

[Abstract] An analytical solution of the problem of focusing antennas with continuous distribution of current is found in a number of works in the literature, where the statement of the problem is simplified by a prescribed geometrical form of the source, by the condition of a sufficiently large remoteness of the focal point from the antenna, by a scalar version of the problem, and by the choice of a simpler limiting condition than the condition of direct fixation of the level of power of the radiation and the condition of reactance. In the present paper, the geometrical form of the source is assumed to be arbitrary, a weak limitation in the form of a transfer of it beyond the region of the sources of the field is applied to the arrangement of the focal point, and together with the amplitude-phase distribution an optimum orientation of current exists, altogether guaranteeing with a specified rate of current, the maximum projection of the vector of the electrical field intensity at the focal point in the selected direction. References 7: 6 Russian; 1 Western.

USSR

UDC 621.396.67

#### ADAPTATION IN LARGE ANTENNA ARRAYS

Kiev IZV.VUZ: RADIOELEKTRONIKA in Russian, Vol 22, No 2, 79, pp 47-53  
manuscript received 26 Sep 78

ZAROSHCHINSKIY, O.I. and KULESHOV, I.I.

[Abstract] Contemporary radar and communication systems must be developed so as to assure specified characteristics under conditions of organized and natural noise. This requirement has lead to a considerable intensification of development of adaptive antenna arrays which carry out a weighted summation of signals received by elements of the array, shaping them and, thereby, troughs in the radiation pattern in the directions of the arrival of interference. The present paper is concerned with the construction of adaptation systems in multimodular antenna arrays. On the basis of a relation obtained with respect to a number of values and with known geometry of all the arrays, it is possible to find the necessary breakdown of the array into modules, the geometrical parameters of the modules, the arrangement and number of elements in a model, and the like. A modified

algorithm of random search and a successive gradient search are discussed. The limiting characteristics of suppression of the noise of a multimodule adaptive antenna array with a control algorithm were investigated on a digital computer. A 36-element linear array was taken with a distance between elements,  $d = 0.76\lambda$ , in which the number of modules varied. Figures 4; tables 1; references: 6 Western.

USSR

UDC 621.396.677 494

ROTATION FIELD OF CONFORMAL PHASED ARRAY OF ROTATING POLARIZATION ELEMENTS, SITUATED ON THE ROTATION SURFACE

Kiev IZV.VUZ: RADIOELEKTRONIKA in Russian, Vol 22, No 2, 79, pp 66-69  
manuscript received 11 Jul 78

KLIMASHOV, A.A. and MAR'IN, N.P.

[Abstract] This short communication considers conformal phased antenna arrays, the shape of which coincides with the streamlined surface of the fore part of an aircraft. This consideration is in contrast with two works in the literature where theoretical and experimental investigations are made of a spherical antenna array with elements of circular polarization. The method shown for calculating the radiation field can be used for conformal arrays with rotating polarization elements situated on conducting surfaces, as well as to find the radiation field with interconnections taken into account. Figures 4; references 4: 3 Russian; 1 Western.

USSR

UDC 621.396.67

RADIATION PATTERN OF MULTI-RING SHAPED SPHERICALLY PHASED ANTENNA ARRAY

Kiev IZV.VUZ: RADIOELEKTRONIKA in Russian, Vol 22, No 2, 79, pp 71-74  
manuscript received 26 Sep 78

FILIPPOV, V.S. and SHATOKHIN, B.V.

[Abstract] A spherical antenna array, the elements of which are evenly arranged with respect to the parallels of the sphere's surface, is one of the possible and promising variations of construction of a spherical array. With the aid of a Poisson summing formula and the method of stationary phase described by the authors in a previous paper (1978), asymptotic expressions are obtained in the present brief communication which characterize

the structure of the radiation field of such an antenna. A calculation was made on a M-4030 electronic computer of the directional diagram of a spherical array of continuous ring-shaped radiators, phased in the direction  $\theta_0 = 0$ . The radius of the sphere  $R/\lambda = 38.2$ , the angle pitch between rings  $\delta\theta = 80^\circ$ . A comparison of the results of the numerical calculation with the approximate estimates from the previous paper shows a small difference consisting of units of a percent. Figures 1; references: 4 Russian.

USSR

UDC 621.396.67

#### ADAPTATION ALGORITHM OF ANTENNA ARRAY WITH LIMITATIONS

Kiev IZV.VUZ: RADIOELEKTRONIKA in Russian, Vol 22, No 2, 79, pp 74-76  
manuscript received 26 Sep 78

ZAROSHCHINSKIY, O.I., KLEYMENOV, S.A. and UGLOV, O.D.

[Abstract] Antenna arrays (AR) with a uniform distribution of the field in the aperture do not make it possible to obtain the maximum signal-to-noise ratio at the output of the antenna in the case of the effect of direct interference. The problem of determining the weighting factor of the elements of the array, which characterizes the distribution of the field in the aperture, with the object of optimizing a chosen quality index (e.g., signal-to-noise ratio) with any interference arrangement is discussed in many papers. Correlation (gradient) algorithms of an adaptive control of weighting factors have had the widest distribution. However, realization of a correlation algorithm of adaptation requires use of signals received by elements of the array, which constructively is not always possible and expedient. The present brief communication proposes a correlation algorithm of an adaptation antenna array using the signals of the antenna array only after weighing. Figures 1; references 8: 4 Russian; 4 Western.

USSR

UDC 621.396.67

#### OPTIMUM CONTROL OF WEIGHING DEVICES OF ADAPTIVE ARRAY

Kiev IZV.VUZ: RADIOELEKTRONIKA in Russian, Vol 22, No 2, 79, pp 81-83  
manuscript received 26 Sep 78

PUZYREV, V.A. and GUROVA, I.I.

[Abstract] This brief communication considers the scheme of an algorithm of optimum control of the weighing devices of surface and airborne phased-array antennas. Figures 1; references 2: 1 Russian; 1 Western.

## CHECKING THE CONTROL SYSTEM OF LARGE CONVEX ANTENNA ARRAYS

Kiev IZV.VUZ:RADIOELEKTRONIKA in Russian, Vol 22, No 2, 79, pp 84-87  
manuscript received 17 Jul 78

KUZNETSOV, YU.V.

[Abstract] This brief communication is concerned with checking the control system of a multimodule convex phased-array antenna. In contrast to image antennas and plane antenna arrays, this antenna requires a device for control of the phase shifters (UUF). On the basis of an analysis of methods of checking computing devices and proceeding from the principles of organization of effective UUF checking listed in the paper, a system of checking was developed for a concrete system of control of nonplanar multimodule phased-array antennas. The system of checking developed makes it possible to discover in the process of operation of the UUF all the separate malfunctions and breakdowns and to localize the position of their origin to the nearest unit (blok) of the UUF. References: 3 Russian.

## SCANNING REFLECTING ANTENNA ARRAY WITH BALANCING OF INTERCONNECTION OF RADIATORS AND ITS POTENTIAL CHARACTERISTICS

Kiev IZV.VUZ:RADIOELEKTRONIKA in Russian, Vol 22, No 2, 79, pp 18-24  
manuscript received 17 Jul 78

SAZONOV, D.M. and SHKOL'NIKOV, A.M.

[Abstract] Problems of theory and optimum design of scanning reflecting arrays are still insufficiently developed. The question remains open concerning the optimum characteristics of these arrays in the condition of balancing the interconnection of elements with the aid of a transfer, nondissipative multipole, which is often called a lobe-forming scheme (DOS). Solution of such a problem, together with an evaluation of the potential possibilities of reflecting arrays with total or partial balancing of the interconnections, also makes it possible to clarify the peculiarities of the spatial method of exciting the elements. In the present work, scanning is produced by variable reflection phase shifters at the inputs of the balancing multipoles. Determination of the parameters of the balancing multipole and the phase shifters leads to the maximum directive gain for each direction of scanning. It is shown that reflecting antenna arrays with optimum loading parameters of a multipole of complex structure assure efficient scanning (without appreciable worsening of characteristics)

in the same sector of angles in which arrays with a closed channel work well. In optimum reflecting arrays with the presence of lobe-forming schemes it is possible efficiently to control the level of the fringe radiation by using irradiation units with a special form of the directional diagram. In so doing the corresponding regularities established earlier for mirror-like antennas retain their value. By and large, as numerous calculations have shown, reflecting scanning arrays with optimum feed and balancing of interconnections with an accurate choice of the locations of reflecting phase shifters in accordance with their potential parameters are almost not inferior to arrays with a closed feeder channel. Figures 4; tables 1; references: 6 Russian.

USSR

UDC 621.396.677.001.494

EFFECT OF THE MUTUAL COUPLING BETWEEN ELEMENTS OF A LINEAR ANTENNA ARRAY ON THE ACCURACY OF THE FOCUSING METHOD OF MEASURING ANTENNA PARAMETERS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24, No 3, Mar 79 pp 620-623  
manuscript received 9 Nov 76; after revision, 8 Jun 77

SNEGIREVA, V.V.

[Abstract] The accuracy of determining the radiation pattern and the directive gain of a linear phased antenna array, by the focusing method on the basis of measurements made in the far zone, is analyzed with the mutual coupling between elements of the array taken into account. Compensation of amplitude errors is considered, these errors contributing most to the distortion of the principal lobe. Calculations show that focusing successively in each direction will ensure the required accuracy of the radiation pattern with measurements made at distances approximately two orders of magnitude nearer than those necessary with focusing only along the axis of the principal lobe. No compensation of amplitude errors is found to be necessary for measuring the directive gain. The author thanks N.M. Tseytlin and D.A. Dmitrenko for helpful discussions. Figures 4; tables 1; references 7: 4 Russian, 3 Western.

USSR

UDC 621.396.677.8.001.5

#### SHAPING RECEIVED BEAMS OF NONPLANAR ANTENNAS BY RADIOOPTIC METHODS

Kiev IZV.VUZ:RADIOELEKTRONIKA in Russian, Vol 22, No 2, 79, pp 25-33  
manuscript received 30 Jun 78

GRINEV, A. YU. and VORONIN, YE.N.

[Abstract] Planar radiooptical antenna arrays (ROAR) with coherent-optical (KO) shaping of received beams are considered in previous works, two of them by the authors of the present paper. Nonplanar antenna arrays, under which is understood radiation systems located on nonplanar geometrical or conductive surfaces (e.g., cylindrical, spherical), make it possible to accomplish wide-angle scanning of space without (or practically without) reduction of directivity. Shaping of narrow radiation (reception) and scanning in similar antenna arrays is a complex technical problem. An even more complicated problem is accomplishment of parallel scanning of radiation, analogous to that which exists in a planar ROAR. The present paper proposes a general principle of synthesis of coherent-optical processors of ROARS, operating in a parallel scanning regime. Consideration of the principal conveniently leads to a model of a continuous aperture of the antenna array (in the form of some continuous recording medium) and a space-time light modulator (in the form of a continuous modulating medium). The results obtained are not difficult to combine into the discrete structures of an antenna array. A processing algorithm of the desired coherent-optical processor is obtained and means for practical realization of the algorithm are shown. A coherent-optical processor of a cylindrical antenna array is synthesized, which reproduces a two-dimensional angular spectrum in a complete solid angle and in so doing does not reduce the resolution and the directive gain of the antenna array. Figures 5; reference 7: 6 Russian; 1 Western.

USSR

UDC 621.396.677.49

#### PATTERN-FORMING CIRCUIT OF MULTIWIRE ANTENNA ARRAY

Kiev IZV.VUZ:RADIOELEKTRONIKA in Russian, Vol 22, No 2, 79, pp 70-71  
manuscript received 14 Apr 78; after revision, 20 Jun 78

YUREV, YU.YA. and SALOMATOV, YU.P.

[Abstract] This brief communication is concerned with a pattern-forming circuit (see figure) which uses a sum-difference method of forming beams

and includes almost half as few elements (directional couplers and sum-difference devices) as a series-connected pattern-forming circuit with the same characteristics. Figures 1; references 3: 2 Russian; 1 Western.

USSR

UDC 53.083.721

TIME-PULSE FUNCTION GENERATOR

Moscow PRIBORY I SISTEMY UPRAVLENIYA, No 2, 1979, pp 22-23

LEYTMAN, M.B., candidate in technical sciences, and MAYOROV, V.G., engineer

[Abstract] In many computing devices problems occur connected with the reproduction of relations of the form  $y = r \sin \varphi$ , and  $x = r \cos \varphi$ . Known devices are characterized by a significant temperature instability of selective circuits ( $t_{sep}$ ) entering into their composition. The generator described in the present paper has increased precision over them. A functional diagram of the generator, a time diagram explaining its operation and the results of tests are presented. Also shown are functional diagrams of the generator's unit for phase stabilization and the shaper of proportional amplitude. Figures 3; references: 3 Russian.

USSR

UDC 62-50

ANALYSIS OF ABSOLUTE STABILITY OF NONLINEAR DISCRETE SYSTEMS BY THE METHOD OF ROOT TRAJECTORIES

Novocherkassk IZV. VUZ: ELEKTROMEKHANIKA in Russian No 12, Dec 78 pp 1318-1328 manuscript received 10 May 76, after completion, 3 Apr 78

RIMSKIY, GENNADIY VASIL'YEVICH, candidate in technical sciences, docent; and SKUDNYAKOV, YURIY ALEKSANDROVICH, graduate student, Minsk Radio Engineering Institute

[Abstract] An effective method of analyzing the absolute stability of nonlinear discrete automatic control systems is the root method, which is free of the deficiencies of the frequency method. In this paper the authors derive root criteria of absolute stability of nonlinear discrete automatic control systems based on the general theory of root trajectories. Analytic equations are derived for root hodographs of three different types, depending on the characteristic of the nonlinear element: functional root hodograph, root hodograph of an arbitrary straight line, and root hodograph of a vertical straight line. It is shown that a sufficient condition of absolute stability of a nonlinear discrete automatic control system is that at least one root hodograph be situated within a circle of unit radius. Figures 2; references 10: 9 Russian; 1 Western.

USSR

UDC 62-501.22

#### OPTIMUM CORRECTION OF A CLASS OF ASTATIC CONTROL SYSTEMS

Novocherkassk IZV.VUZ: ELEKTROMEKHANIKA in Russian No 12, Dec 78  
pp 1334-1341 manuscript received 19 Sep 77

KUKHARENKO, NIKOLAY VASIL'YEVICH, candidate in technical sciences, docent,  
Northwest Polytechnical Correspondence Institute

[Abstract] A method is proposed for synthesizing control systems with zero static error in the case of a nonvanishing signal and perturbation inputs. First an astatic control system that guarantees a zero static error is synthesized by introducing integrating elements, and the dynamic error of the resultant system is then minimized by optimum correction based on the method of analytical design [A.M. Letov, "Analiticheskoye konstruirovaniye regulyatorov" (Analytical Design of Regulators), AVTOMATIKA I TELEMEXHANIKA, No 4, 1960, pp 436-441; No 5, pp 561-568; No 6, pp 661-665]. Application of the proposed technique is illustrated by synthesis of a control system that is representative of a wide class containing an integral regulator connected in a feedback circuit. A numerical example is given for remote control of a marine diesel. Figures 2, references: 7 Russian.

USSR

UDC 621.31.016.35.001.24

#### USE OF VARIABLE-STRUCTURE FILTERS IN PROBLEMS OF AUTOMATIC CONTROL

Moscow IZVESTIYA AKADEMII NAUK SSSR, ENERGETIKA I TRANSPORT in Russian,  
No 6, Nov-Dec 78 pp 146-150 manuscript received 24 Aug 77

COLEMO, B.Z., Moscow

[Abstract] Variable structure filters can be used in electric power systems and in closed-loop automatic control systems, where they will respond better than linear nonadaptive or adaptive filters to fast perturbations. A typical example of the first kind of application is to ensure stability of and to limit transients in a doubly-excited synchronous generator operating into an infinite-power busbar during strong perturbations. A typical example of the second kind of application is to control the free motion or the forced motion of a neutral object with fourth-order astatism. The feasibility and the advantages of using such filters are established in the case of a synchronous generator by simulation with a system of linearized fifth-order differential equations and in the case of automatic control of

motion by an appropriate transient analysis of a normal random process with noise. The calculations have been programmed on a GVS-100 analog computer. Figures 5; references: 5 Russian.

USSR

UDC 621.436-531.6.001.24

ON CALCULATING THE OPTIMUM PARAMETERS OF AN AUTOMATIC CONTROL SYSTEM WITH DIFFERENT RESPONSES TO PERTURBING AND CONTROLLING SIGNALS

Novocherkassk IZV.VUZ: ELEKTROMEKHANIKA in Russian No 12, Dec 78  
pp 1329-1333 manuscript received 25 Oct 77

KACHKOV, VLADIMIR VASIL'YEVICH, instructor; and NERUBENKO, Georgiy Petrovich, candidate in technical sciences, Scientific Worker, Nikolayev Shipbuilding Institute

[Abstract] It is shown that an automatic control system can be optimized with respect to responses to both perturbing and controlling signals by simultaneously minimizing two criterion functionals: 1) For the quality of the control system in terms of its frequency properties when it is considered as a servosystem; and 2) For a quadratic integral evaluation in terms of the quantity to be controlled when it is considered as a stabilizing system. A system of equations is derived for determining the optimum parameters in the given sense for a wide class of automatic control systems. A nomogram is given for determining the parameters of a system that is stable for a predetermined antihunt index and has a minimum quadratic integral of the quantity being controlled for a perturbing effect with a predetermined velocity error. Figures 2, references 4 Russian.

USSR

UDC 681.3.05

#### SELECTION AND STORAGE DEVICE USING INTEGRATED MICROCIRCUITS

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian, No 1, Jan-Feb 1979,  
pp 76-77 manuscript received 17 Jun 77

KRYLOV, I.K. and KULESHOV, V.N.

[Abstract] A selection and storage device is a component of contemporary analog-to-digital converters, which fixes the momentary values of analog signals at a determined moment of time. The present paper describes a selection and storage device of the open type, developed for an 8-digit (razryadnyy) analog-to-digital converter. It is based on the widely distributed integrated microcircuits of series 101, 140 and 190. The principal circuit of the device is shown and discussed, and the results of experimental investigations of it are presented. The ratio of the time of storage to the time of selection is not less than  $10^5$ . The device can be used for storage of analog signals in multichannel systems of assembly and processing of information. Figures 1; references: 2 Russian.

USSR

UDC 681.14.001.57

#### M-6000 DISPLAY FOR SPECTRA PROCESSING

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian, No 1, Jan-Feb 1979,  
pp 72-73 manuscript received 10 Mar 78

KALASHNIKOV, A.M., PETROV, I. YU. and SHERMET'YEV, A.K.

[Abstract] Recently mini-electronic computers have found use in the collection and processing of spectrometric information. In so doing, the spectrum, the program of processing and the software of the display necessary for layout of the spectrum and checking of the processing procedure must be disposed in the computer's memory. The software of general purpose displays occupies a considerable volume of the memory, which limits use of the basic complexes of a mini-electronic computer. The present paper discusses the problem of creating a specialized display for processing spectra, the program of which would be minimal. This display carries out a search for a peak in the spectrum, its study with an automatic selection of scale, a subsequent search for a peak if it is not necessary to process the found peak, or transfer of the control to the memory with a following simultaneous indication of the original spectrum and the approximating function. The

display program is written in MNEMOKODE and occupies 180 units in the M-6000 memory. Control of the display's operation is carried out from the control console of the M-6000. The circuit of the display is presented. Figures 1; references 2: 1 Russian; 1 Western.

USSR

UDC 691.142.4

# INTRODUCTION INTO ELECTRONIC COMPUTER OF TWO INFORMATION FLOWS FROM INDEPENDENT SOURCES

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian, No 1, Jan-Feb 1979, pp 73-75 manuscript received 24 Aug 77

PECHENIN, V.V., CHUMACHENKO, A.A. and SHUL'GIN, V.I. Khar'kov Aviation Institute

[Abstract] A device is described, intended for introduction into an electronic computer of two independent flows of information. During development of the device the following was taken into consideration: the device must assure introduction of information into each of the channels with a frequency of entry of information words not greater than  $1/2 \gamma_{\min}$ , where  $\gamma_{\min}$  is the speed of the satellite processor (input device) of the electronic computer. During arrival of an information word from any of the sources at the moment when the electronic computer is occupied with the introduction of a word from another source, the device must assure storage of the word obtained and its introduction by freeing of the electronic computer. The developed device was employed during an analysis of the statistical properties of two narrow-band processors with use of the "Nairi-3" electronic computer. Figures 3; references: 2 Russian.

USSR

UDC 621.397

#### VIDEO SIGNAL TRANSMISSION ON TWO CARRIER FREQUENCIES

Moscow RADIOTEKHNIKA in Russian Vol 33, No 12, Dec 78 pp 82-84 manuscript received 9 Nov 77

KOVALENKO, V. I.

[Abstract] To make more complete use of communication channels and transmitter power and to improve receiver sensitivity in television broadcasting, it is proposed that the AM video signal be transmitted on two carrier frequencies at either end of the frequency band of the television channel. This idea can be realized if the audio signal is transmitted on the same frequency as the video signal by using pulse-frequency modulation during the horizontal blanking pulse time. Then the unused audio carrier frequency is used as the second carrier frequency for the image, and the amplitude-frequency response of the video channel is expanded to 6.5 MHz and becomes symmetrical relative to the carrier frequencies. A theoretical and experimental study of the proposed method of video signal transmission showed no interference in detection of the sum-frequency signal with the exception of a difference frequency that can be filtered out. The proposed transmission technique does not complicate the receiver and gives considerable energy advantages as compared with the single-band method, as well as enabling multiplexing by quadrature modulation of the two carriers with several signals. Figures 3, references 4 Russian.

USSR

UDC 621.397.2.037.372

#### TRANSMISSION OF TELEVISION SIGNALS IN DIGITAL FORM OVER BALANCED CABLES IN TELEVISION STATIONS

Moscow TEKHNIKA KINO I TELEVIDENIYA in Russian No 11, 1978 pp 31-34

BAZHIN, V. V., MAUMOV, V. YA., NIKOLAYEV, G. O. and SHOSTATSKIY, N. N.,  
All-Union Scientific-Research Institute of Television

[Abstract] The widely used 10-pair TPP-10x2x0.5 telephone cable, about 70 m in length, was investigated as to its suitability in transmitting television signals in digital form over balanced cables in television studios. The studio signal clock frequency is 18.75 MHz. This value is the sum of the brightness digitizing frequency and two color-difference component frequencies. A digital stream at this transfer rate (18.75 Mbits/s) can be transmitted without distortion when the cutoff frequency of the pass-band in each cable pair is somewhat larger (about 1.2-1.3 times) than half

the studio signal clock frequency. Crosstalk attenuation at the near end for different pair combinations varies from 33 to 48 dB at 12 MHz and from 32 to 41 dB at 20 MHz. At the far end, crosstalk attenuation for different pair combinations varies from 39 to 63 dB at 12 MHz and from 39 to 50 dB at 20 MHz. As to signals transmitted over balanced cables being affected by induction interference from radio stations, measurements showed that at best it is about 20 mV. As to matching of end fittings with the balanced cables, the frequency range higher than 100-150 kHz is sufficient. The modulus of the characteristic impedance in this range is approximately 120 ohms. Figures 7; references 5: 4 Russian, 1 Western.

USSR

#### HOW TO REDUCE THE MUTUAL INTERFERENCE OF TELEVISION TRANSMISSION

Moscow VESTNIK SVYAZI in Russian, No 2, Feb 79, pp 27-29

LOKSHIN, M.G., candidate in technical sciences, Staff Member NIIR  
(Scientific-Research Institute of Radio)

[Abstract] In connection with the rapid development of the multiprogram network of television broadcasting, the problem of reducing the mutual interference of television transmitters is of great importance. The following are among a number of basic ways for reducing this interference: introduction of operating conditions for radio transmitters which provide a reduction of the protective ratios; widespread introduction into the network of receiving antennas for collective and individual use of II and III categories of complexity, among them those for reception of signals with vertical polarization; utilization of orthogonally polarized signals; decrease of the relative radiated power of signals of the sound track of television; increase of the number of nominal values of the powers of standard TV transmitters, and wide use during construction and modernization of TV stations of higher antenna supports. Figures 4.

## SUBSCRIBER'S VIDEO TERMINAL BUFFER

Moscow *TEKHNIKA KINO I TELEVIDENIYA* in Russian No 2, 1979 pp 42-46

GOLOVIN, N.I. and CHEPURNYAK, V.P. Republic Computer Center, Moldavian SSR

[Abstract] The development and popularity of computers and mini-computers has elicited the need for user terminal which can be interfaced via telephone and other common communications lines. The Servis automated subsystem is available for urban and interurban telephone and telegraph lines. CRT terminals require buffers to have a hand-shaking capacity with various kinds of computers that transmit at different rates. Information can be provided to users about aircraft and train departures; telegrams and journals; to deliver commercial information to managers; for video games; to obtain telephone numbers and addresses; to inquire into patents, etc. Requirements include: ability to interface with computer; minimum error; buffer storage; conversion of coded information; and modulation of high frequency signals. There are types of hook-up: computer to CRT terminal and computer to computer. Figures 6; references: 3 Russian.

## OPTICALLY-CORRECTED OPTICO-MECHANICAL SCANNING DEVICE

Moscow *TEKHNIKA KINO I TELEVIDENIYA* in Russian No 2, 1979 pp 49-51

FRIDLYAND, I.V., All-Union Scientific Research Institute of Television and Radio Broadcasting

[Abstract] With the development of optical recording systems, experts have shown interest in optico-mechanical scanning devices. These devices are based on the principle of scanning using a rotating drum. Their motors are usually synchronous and relatively simple methods can be used to achieve synchronous phase by shaping motor power supply pulses from a reference oscillator. Problems are more serious when it comes to providing synchronized phase if there is instability in the speed of the drum's rotation. Correction of time distortion of the image reduces inertia of the control object in any optico-mechanical scanning device. Based on the method of optical correction, the control system of the optico-mechanical scanning device has greater dynamic accuracy, high speed, low control power dissipation. The optical correction circuit does not affect motor control circuit parameters. V.G. Sashnikov took part in the experimental work. Figure 2; references: 8 Russian.

## TELEVISION TRANSMISSION OF FRESNEL HOLOGRAMS

Moscow RADIOTEKHNIKA in Russian Vol 33, No 12, Dec 78 pp 66-70 manuscript received 24 Oct 77

GOFAYZEN, O.V. and MINDEL', A. V.

[Abstract] Previous research has shown that the frequency-contrast characteristic of a television holographic system influences the reconstructed image, but insufficient attention has been given to the specifics of the distortions of the reconstructed image associated with discretization of the hologram in the process of television transmission. In particular, it is not clear which distortions of the reconstructed image result from discretization in analysis, transmission over the electric channel and synthesis. Because this issue is fundamental to holographic television, it is the topic of this paper. The analysis is limited to consideration of the transmission of a single informative component of a hologram corresponding to the real image of an object with given amplitude transmission. An expression is derived for the spectrum of spatial frequencies of the distribution of amplitudes of the light field in the reconstructed image of the object. Characteristic distortions of the image can be studied by analyzing this expression. It is concluded that the diffraction orders formed as a result of discretization of the hologram, the aperture distortions in analysis and synthesis of holograms and also distortions that arise in transmission over the electric channel lead to loss of clarity and contrast of the reconstructed image. References 14: 13 Russian; 1 Western.

## CURRENT STATUS OF DIGITAL MAGNETIC AUDIO RECORDERS

Moscow TEKHNKA KINO I TELEVIDENIYA in Russian No 11, 1978 pp 12-18

PARKHOMENKO, V. I. and SHCHERBINA, V. I. All-Union Scientific-Research Institute of Television and Radio

[Abstract] Digital magnetic audio recording improves all reproduced-signal parameters. The dynamic range achieved is 70-80 dB, coefficient of harmonic distortions, 0.1 percent and nonuniformity of amplitude-frequency characteristics in the working frequency range,  $\pm 0.1-0.5$  dB. Disadvantages of digital magnetic recording include the need to expand the passband of

the record-reproduce channel 25 compared with the passband of the conventional analog recording channel. Studio-quality digital magnetic recorders must satisfy requirements that at times are contradictory: high quality of reproduced signal, small consumption of carrier medium not exceeding the value for analog magnetic recorders, compatibility with studio digital and analog equipment and with digital communication channels, relatively low cost of digital magnetic recorders in series manufacture, option of standardizing phonograph records and others. Of the known recording techniques, longitudinal multitrack recording is advantageous because of its relatively low recording speed (19.05, 38.1 cm/s) and thus low wear of magnetic heads and carrier. In a table, parameters and specifications are given for 20 digital magnetic recorders from Japan, the United States and Great Britain. Still unsettled are problems of selecting format and modulation. Tables 1; references 16: 1 Russian, 15 Western.

USSR

#### DIGITAL EQUIPMENT IN VIDEO RECORDING AND TELEVISION BROADCASTING: SURVEY OF DISCUSSIONS

Moscow *TEKNIKA KINO I TELEVIDENIYA* in Russian No 11, 1978 pp 35-44

MAKOVEYEV, V. G., LISHIN, L. G., MIKHNEVICH, A. V., SHTEYN, A. B., KHAIMOV, V. Z., KHEBOROV, V. A., SHILO, V. L., GITLITS, M. V., TSUKKERMANN, I. I. and KRIVOSHEYEV, M. I.

[Abstract] Digital television was discussed on 28 Apr 78 at the concluding session of the Seventh Scientific-Technical Conference of the All-Union Scientific-Research Institute of Television and Radio Broadcasting. Taking part in the discussion were representatives from the following organizations: All-Union Scientific Research Institute of Television and Radio Broadcasting; All-Union Scientific Research Institute of Television; Moscow Scientific Institute of Television Engineers; NIIR (expansion unknown. Possibly Scientific-Research Institute of Radio); All-Union Correspondence Electrotechnical Institute of Communications and others. Most contributions dealt with the practical realization of advances in digital techniques in video recording and television broadcasting. Two problems were outlined: making a fully digital video recorder and applying simple analog video modulation followed by digital signal processing. Digital and analog equipment successfully interact in broadcasting equipment serving different purposes. Subjects under discussion included: digital methods and TV broadcasting; digital video recording in television broadcasting; choice of videophonogram for digital video modulation; digital systems of processing video signals and memory blocks in modern television broadcasting; digital sound recording; and digital television in the MCCR (International Consultative Committee of Radio Communications). Figures 7.

Certain Aspects of Radioastronomy,  
Satellites and Space Vehicles

USSR

A DIRECT-CONVERSION 28 MHz SATELLITE COMMUNICATIONS RECEIVER

Moscow RADIO in Russian No 12, 1978 pp 17-18 plus insert

POLYAKOV, V., RA3AAE, Moscow

[Abstract] A ten-metre receiver is described for use in the 29.3-29.6 MHz region recommended for amateur communications via satellite-borne radio-relay systems. The unit is designed for use with satellites in circular orbits of up to 2000 km altitude with repeater output power of about 1 W. The schematic diagram of the receiver is explained. Sensitivity is no worse than 0.3  $\mu$ V for a signal-to-noise ratio of 10 dB. Input impedance is 75  $\Omega$ . The receiver has a selectivity of no worse than 35 dB with detuning by  $\pm 10$  kHz. Amateur radio signals on CW and SSB can be received through simple antennas. Figures 2.

USSR

COMMUNICATION THROUGH SATELLITE "RADIO": CONSTRUCTION OF TRACKING DIAGRAM

Moscow, Radio, No 1, Jan 79, pp 17-19 (plus unnumbered insert)

DOBROZHANSKIY, V. Laureat of USSR State Prize

[Abstract] Papers concerned with the construction of a tracking diagram for a relay earth satellite were previously published by the author in Radio (1975, 1977). Now, when the real parameters of the orbit of the amateur satellites "Radio-1" and "Radio-2" are known, this problem is considered more concretely. These satellites entered into an almost circular orbit close to polar. The orbit has the following parameters: Orbiting period (T), 120.4 minutes; Inclination (i), 82.6°; height (H), 1724 km in apogee and 1688 km in perigee. For calculating purposes the author considers that  $H = 1700$  km. The error thus caused in determining possible times of communication through the satellite is insignificant. In order to forecast the possible sessions of communication it is necessary to construct a tracking diagram for the satellite. The process of constructing such a diagram (in the form of a chart in the so-called stereographic polar projection of the northern hemisphere), as well as the method of plotting the zones of maximum radio usability, are explained in detail. The relay satellites of the International Radio Amateur organization AMSAT have orbits close to circular and circumpolar. Determination of the zones of their radio visibility and calculation of traces can be carried out by the procedures stated in the present paper. Figures 1; tables 2; references: 2 Russian.

USSR

## RADIO AMATEUR EARTH SATELLITES

Moscow RADIO, No 1, Jan 79, pp 4-8

GRIF, A.

[Abstract] On 26 October 1978 the rocket-carrier of "Radio-1," "Radio-2," and "Kosmos-1045" was launched, and two radio amateur outer space relays entered into orbit around the earth. Creation of a satellite system for organization of communication among radio amateurs was carried out by students of higher educational institutes for scientific-technical experiments and educational work. The radio amateur satellite communication system was called upon to solve problems of an educational-experimental, sport and scientific-technical nature. The system makes it possible for the operator to perform experiments with respect to employment of several outer space objects and to conduct a comparative analysis of the operation of amateur equipment under outer space conditions. The "Radio-1" and "Radio-2" satellites, in spite of the fact that they solve the overall general problem--to serve for amateur outer space communication--have some differences in the construction of the capsules, antennas and other systems. However, both satellites use just the same relay equipment, equipment of the command radio line and telemetering system. The space-borne apparatus of satellites "Radio-1" and "Radio-2" and the construction of the satellites are discussed with the aid of photographs of the interior and exterior of the satellite. For control of the "Radio-1" and "Radio-2," DOSAAF (All-Union Voluntary Society for Assistance To The Army, Air Force And Navy Of The USSR) created the Central Reception--Command Point (TsPKP), RS3A, in Moscow; a Peripheral Reception--Command Point (PKP), RSOA, in Arsen'yev, Primorskiy Kray, and a mobile PKP, RS3B. In addition, on the base of the Moscow Power Engineering Institute, an educational observation point was unfolded. A photograph is shown of the control and monitoring desk of the TsPKP. Both Soviet radio amateurs and amateurs of all the countries in the world can operate through the relays installed on the "Radio-1" and "Radio-2." In so doing they make use of the ordinary station identification letters and are guided by the rules of amateur communication. It is possible to carry out communication by both telegraph (O.1A1) and single-sideband (3A3J). Radio stations UK3A (TsRK--Central Radio Club of DOSAAF), UK3R (the journal "Radio") and the reception-command points--RS3A, RS3B, RSOA--regularly transmit information concerning the schedule of operation of "Radio-1" and "Radio-2," forecasts of their movement and the time of transmission of telemetric information. Current information is published in the newspaper "Soviet Patriot." The journal "Radio" plans to publish on a regular basis material concerned with on-board and terrestrial equipment, the course of operation through the satellite system, methods of reception and decoding of telemetering, methods of orbital measurements,

sport measures and planned scientific-technical experiments. Operators of Soviet and foreign stations can participate in reception of telemetering information and be attracted to carrying out radio monitoring of orbits under the direction of the reception-command points of DOSAAF. Figures 9.

USSR

**"MARS-2M" TRANSPORTABLE STATION FOR SATELLITE COMMUNICATION**

Moscow VESTNIK SVYAZI in Russian, No 4, Apr 79, pp 20-21

TSIRLIN, I.S., candidate in technical sciences, Chief of Laboratory, NIIR (? Scientific-Research Institute of Radio); and TRAKHTENBERG, K.G., Chief of sector.

[Abstract] Prompt organization of television transmissions from the location of events is often necessary. The first step in solving this problem was the creation of the multipurpose, small-sized station for satellite communication, the "Mars-1." In the process of practical operation of this station certain structural shortcomings were revealed. The new station, the "Mars-2M" is free from the shortcomings of the earlier model, and in a number of indices surpasses it. The "Mars-2M" assures: transmission and reception of one program of color television; transmission and reception of signals of two programs of sound accompaniment; organization of one telephone-telegraph channel for service traffic; organization of 3--4 duplex telephone and 4--6 telegraph communication channels. The station assures reception of signals in the 4 GHz band, and transmission in the 6 GHz band. A description is given of the various units of the "Mars-2M" and a photograph of the station is presented. Figures 1.

USSR

UDC 621.3.011.7

A SPECTRAL METHOD OF ANALYZING THE INTERNAL NOISES OF LINEAR CIRCUITS

Moscow RADIOTEKHNIKA in Russian Vol 33, No 12, Dec 78 pp 76-79 manuscript  
received after completion 15 May 78

TERPUGOV, N. V.

[Abstract] A method is considered for solving technical problems involved in determining the general level of noise in active and passive linear circuits based on direct utilization of the ideas of spectral and mutual spectral densities of the internal noise sources of the circuit as random processes and linear operators relating them to the circuit section where it is required to determine the overall noise level. It is shown that if the noise is taken as a steady-state ergodic process (connections of resistors, transistors, microcircuits), the proposed method is superior to the method of complex amplitudes in that the averaging procedure is reflected in quadratic forms of the equations for spectral densities, which simplifies circuit analysis. Figures 6, references 5: 3 Russian, 2 Western.

USSR

UDC 621.3.019.4

OPTIMAL NONLINEAR FILTRATION OF A PULSE PROCESS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24, No 3, Mar 79 pp 551-556  
manuscript received 22 Dec 77

TIKHONOV, V.I. and YERSHOV, L.A.

[Abstract] The theory of optimal nonlinear filtration is applied to one Markov model of pulse signals appearing together with noise in a continuum of states. First the Kolmogorov-Feller integro-differential equation is solved for the probability density of a purely discontinuous jump process. Then an additive mixture of signal and normal white noise is considered and the a' posteriori probability density of the useful process calculated by the algorithm of optimal nonlinear filtration which in this case involves the Stratonovich integro-differential equation. Figures 1; references: 5 Russian.

USSR

UDC 621.316.771.011.73

**DESIGNING OF CHANNELS WITH RESISTIVE CONTROLLED ATTENUATORS ACCORDING TO A  
PREDETERMINED FORM OF FREQUENCY RESPONSE**

Moscow RADIOTEKHNIKA in Russian Vol 33, No 12, Dec 78 pp 71-74 manuscript  
received 6 Apr 78

OKULICH, N. I.

[Abstract] A procedure is proposed for synthesizing amplification channels with nondistorting resistive attenuators from a given shape of the frequency response curve in two formulations: 1) The structure of the channel and the parameters of its elements are predetermined; 2) The structure of the channel is purposely varied to satisfy simultaneously the requirements of nondistorting control and predetermined form of frequency response. Nondistorting control is taken to mean regulation of the transmission factor while the frequency response remains stable in shape. An example is given. Figures 2; tables 1; references: 3 Russian.

USSR

UDC 621.372.3

**A SIMPLE METHOD OF DETERMINING THE LIMITING TRANSMISSION FACTOR OF A LINEAR  
MICROWAVE TWO-TERMINAL-PAIR NETWORK**

Moscow RADIOTEKHNIKA in Russian Vol 33, No 12, Dec 78 pp 84-86 manuscript  
received 14 Dec 77

VOROPAYEV, YU. P. and ONISHCHUK, A. G.

[Abstract] A simple method is proposed for finding the extremum values of the transmission factor of an arbitrary linear passive two-terminal-pair network for microwave frequencies from measurements of the standing-wave ratios on the input and output branches of the network. It is shown that if a variable load is connected to the output leg of the network with reflectance that traces a circle on the plane of the complex variable, the reflectance at the input will also trace a circle. A low-loss shorting piston is used as the load, and the resultant maximum and minimum scalar values of the SWR are measured at the input and output. Figures 2; references 5: 4 Russian; 1 Western.

USSR

UDC 621.372.832

**SYNTHESIS OF SYMMETRIC DIRECTIONAL COUPLERS USING COUPLED NONHOMOGENEOUS TRANSMISSION LINES**

Moscow **RADIOTEKNIKA I ELEKTRONIKA** in Russian Vol 24, No 3, Mar 79 pp 474-480  
manuscript received 27 Dec 76; after revision, 14 Jun 78

**MESHCHANOV, V.P. and CHUMAYEVSKAYA, G.G.**

[Abstract] Synthesis of symmetric directional couplers using coupled non-homogeneous transmission lines is considered directly on the basis of the differential equation for an octupole network. The problem is solved from a practical standpoint, namely in terms of best coverage of the operating frequency range for a given maximum departure of the crosstalk attenuation from its nominal value. Such transmission lines propagating TEM modes with a directionality of the second kind are described by the Riccati differential equation in element  $S_{12}$  of the scattering matrix. With a linear approximation of this element, the parameters of the electric circuit are calculated by the second Remez polynomial algorithm for not only weak but also stronger coupling. Experimental data agree very closely with the calculated, some slight differences being attributable to the error in calculations as well as to geometrical imprecision in the manufacture of test specimens. Figures 3; tables 2; references 8: 6 Russian, 2 Western.

USSR

UDC 621.373.7:621.375.7

**PARAMETRIC INSTABILITY IN SELECTIVE SYSTEMS WITH ONE OR TWO DEGREES OF FREEDOM, INCLUDING A VARIABLE CAPACITANCE**

Moscow **RADIOTEKNIKA I ELEKTRONIKA** in Russian Vol 24, No 3, Mar 79 pp 562-570  
manuscript received 18 Jan 78

**TURKIN, A.A., OB'YEDKOV, A.F. and BALASHEV, YU.V.**

[Abstract] The stability of periodic processes in non-linear selective systems with small perturbations is analyzed by a new method of integrating the linear differential equations which describe such perturbations and have periodically varying coefficients. The perturbation equations are presented in the form of a structural graph so that the frequency of periodic solutions as well as the conditions of their existence and their limits can be systematically established. It is first demonstrated on a single-stage system containing a variable capacitance, and then extended to a system consisting of two stages with a common variable coupling capacitance.

Here three feedback loops exist: two internal ones around each stage respectively and an external one around both stages. Accordingly, three kinds of oscillations occur here: the first kind caused by any one internal feedback, the second kind caused by the external feedback, and the third kind either caused by a combination of one internal feedback with the external feedback, or with all three feedback loops closed caused by oscillations of the second kind. The open-loop transfer ratio is used in each case for determining the conditions of excitation, according to C. Mason's rule, with elimination of arbitrary quantities. Another advantage of this method is its universality. Figures 5; references 12: 10 Russian; 2 Western.

USSR

UDC 621.385.049:621.372.542.21

CONDITIONS FOR SUPPRESSION OF SMALL PERTURBATIONS IN THE PRESENCE OF A STRONG MONOHARMONIC SIGNAL BY MEANS OF A SERIES CHAIN OF AMPLIFIERS

Moscow RADIOTEKNIKA I ELEKTRONIKA in Russian Vol 24, No 3, Mar 79 pp 643-647 manuscript received 20 Oct 78

DIKHTYAR, V.B. and PARAMONOV, B.M.

[Abstract] A nonlinear amplifier used as a radio engineering device can be regarded as a series circuit consisting of an input filter, a nonlinear element and an output filter. The amplitude characteristics of a large class of nonlinear amplifiers can be approximated by a power-law relation between output and input signals. Here the performance of a series chain of such amplifiers with a generally polyharmonic and specifically a 2-frequency input signal is calculated accordingly, this representing the case of a strong monoharmonic input signal with small perturbations. Subsequently the conditions are established under which the perturbation gain will be smaller than the signal gain in each amplifier stage. These conditions are expressed in terms of constraints on the transfer functions of input and output filters, on the power exponent of the amplitude characteristics, and on the interstage coupling for a given coupling between oscillations at different frequencies. Figures 4; references: 6 Russian.

USSR

UDC 621.391

#### CHARACTERISTICS OF SYSTEMS WITH DELTA MODULATION

Moscow RADIOTEKNIKA in Russian Vol 33, No 12, Dec 78 pp 7-15 manuscript received 25 May 77, after abridgement, 27 Jul 78

BORTNYAKOV, YU. L.

[Abstract] An analysis is made of the characteristics of data transmission systems with classical delta modulation. Expressions are derived for calculating mathematical expectation and variance of the transmission error in such systems for undifferentiable and differentiable processes with consideration of uncertainty of initial data and inaccuracy in realization of the circuit elements. Optimum characteristics are calculated and tabulated for systems with differentiable and with nondifferentiable processes. The results show that in many instances optimum choice of the parameters of delta modulated transmission systems can appreciably reduce error variance. Delta modulated systems are compared with pulse-code modulated systems for error variance. It is shown that the effectiveness of using delta modulation instead of pulse-code modulation increases with decreasing ratio of the pulse duration to the time constant of RC circuits and with a reduction in the probability of error in the communication channel. Figure 1; tables 1; references: 10 Russian.

USSR

UDC 621.391.8

#### ANALYSIS OF THE DETECTION CHARACTERISTICS OF DIGITAL INTERPERIOD PROCESSING SYSTEMS

Moscow RADIOTEKNIKA in Russian Vol 33, No 12, Dec 78 pp 40-46 manuscript received 24 May 77

POPOV, D. I.

[Abstract] A general method based on determination of moments of multivariate discrete distribution is used to analyze systems of interperiod processing that utilize digital band-elimination and bandpass filters of arbitrary configuration. Coherent and combined processing systems are considered, depending on the method of signal accumulation (coherent or incoherent). The proposed method of analysis is applicable to both steady-state and transient operating conditions without imposing any restrictions on the correlation properties of the signal and interference,

the number of quantization levels of the analog-digital convertor or the structure and characteristics of the filters. The resultant expressions can be used in digital computers either as special programs or as standard sub-programs. Figures 3, references 6: 5 Russian, 1 Western.

USSR

UDC 621.391.833

#### SPECTRAL CORRELATION CHARACTERISTICS OF A SINGLE-CHANNEL INTERFERENCE AUTOCOMPENSATOR

Moscow *RADIOTEKNIKA I ELEKTRONIKA* in Russian Vol 24, No 3, Mar 79 pp 545-550  
manuscript received 18 Jul 77

ARZAMASOV, S.N., MALAKHOV, A.N., MUZYCHUK, O.V. and POZUMENTOV, I.YE.

[Abstract] The spectral correlation characteristics of a quadrature single-channel autocompensator which suppresses not only "fast" but also "slow" interference signals are analyzed. Calculations are performed by the method of cumulative approximations, on the basis of statistical relations between the envelope of interference signals and fluctuations of the driving signal. Thus any degree of accuracy can be achieved without restrictions on the effective power and the relative correlation time of interference signals. The analysis begins with the dynamic voltage equations for such an autocompensator with identical compensating channels. As the effective interference power increases, the power spectrum of the driving voltage is found to first "rise" and then to widen while "dropping" again. The spectrum of uncompensated output noise "rises" at frequencies about the reciprocal of the time lag between channels (main and compensating antenna). Figures 3; references 9: 7 Russian, 2 Western.

USSR

UDC 621.394.62:621.391.037.372

# LIMITING POTENTIAL INTERFERENCE IMMUNITY OF RECEPTION OF VIDEO PULSE SIGNALS

Moscow *RADIOTEKHNIKA* in Russian Vol 33, No 12, Dec 78 pp 46-52 manuscript received 5 May 77

POROKHOV, O. N.

[Abstract] The author analyses the potential interference immunity that limits distinguishability of binary signals received against a background of additive white gaussian noise. Signal functions are considered that involve transmission of pulses of opposite polarity with each binary symbol, the signals being differentiated by alternating sequences of polarities during the clock cycle. Such diphase pulses satisfy an important condition for maximizing potential interference immunity of a binary communication system: opposition of signal functions. Optimum signal filtration is considered as a basis for maximizing the distinguishability of opposite diphase sequences and forming a clock-signal synchropulse with defined fixed phase from a random diphase pulse signal sequence. Laboratory studies and line tests have shown that the interference immunity of diphase pulse signals is close to the theoretical limit, and that the number of errors is chiefly odd, indicating absence of influence on doubling. The author thanks L. M. Fink and B. A. Kalabekov for interest in the work. Figures 6; references 14: 10 Russian; 4 Western.

USSR

UDC 621.395.341.(5)

# NEW SYSTEM OF AUTOMATED COMMUNICATIONS IN A POWER GRID

Moscow *ELEKTRICHESKIYE STANTSII* in Russian No 11, 1978 pp 21-23

ARTIBILOV, M. A., Candidate of Technical Sciences, and GOL'DSHTEYN, YE. M., Integrated Dispatching Control of the Urals

[Abstract] Two requirements that dial office systems must satisfy for use in the production telephone exchanges of the USSR Ministry of Energy are: 1) Possibility of fully automatic communication with the city dial office and 2) Possibility of connection to toll service channels. One dial office meeting these requirements is the 400Ye "Krosspoynt" YeSK dial office, produced by the Resprom Association of the People's Republic of Bulgaria under Siemens license. A main feature of this dial office is a central programming unit: it executes several functions, depending on requirements

and user category. Dial office specifications, for the IIIW design modification, are: number of subscribers—400, number of trunks to the city dial office—40, number of intercommunication cord sets—48 and working voltage of dial office—48 volts. This dial office modification is operated in the Urals Integrated Dispatching Control. Five outgoing and five incoming lines link the dial office with the ATS-54 city dial office (only 100 subscribers are allowed city dial office connections). Dial office power supply comes from built-in rectifiers connected to a 220 V, 50 Hz single-phase line. Figures 1.

USSR

UDC 621.396.96:621.391.26

**DETECTION OF SIGNALS IN THE PRESENCE OF INTERFERENCE WITH NOISE FREQUENCY MODULATION WITHIN THE HIGH-FREQUENCY RANGE**

Moscow **RADIOTEKNIKA I ELEKTRONIKA** in Russian Vol 24, No 3, Mar 79 pp 623-626  
manuscript received 16 Jun 77

**DANILOV, V. A.**

[Abstract] Fluctuation with noise frequency modulation, a major source of active interference, is analyzed according to a model in which it appears as an additive mixture of FM fluctuation and atmospheric (non-Gaussian) HF noise. The probability densities of the process, calculated by the method of characteristic functions, yield the performance parameters of the optimal signal detector and of receivers with standard immune channels such as, for example, one with a nonlinear element in series before a Gaussian detector, with these parameters and especially the gain in signal-to-noise ratio being functions of the ratio of FM fluctuation power to noise power. Figures 3; references 9: 8 Russian; 1 Western.

USSR

UDC 621.396.96:621.391.26

ADAPTIVE DETECTION OF A SIGNAL SUBMERGED IN GAUSSIAN INTERFERENCE OF UNKNOWN POWER

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24, No 3, Mar 79 pp 626-630 manuscript received 15 Jul 77

VLASOV, I.B. and YERIKALOV, V.N.

[Abstract] Many problems of signal detection can be reduced to the testing of alternative hypotheses about the probability density of the observed quantity. When the probability density is also a function of the estimate, then an adaptive detection algorithm can be constructed. Here, with the a priori distribution of the probability density of the estimate known, an adaptive algorithm is constructed on the basis of the statistics of the absolute and maximum likelihood ratio. This algorithm is applied to post-detector detection of a signal with a constant amplitude and unknown phase, submerged in noise with a Rayleigh distribution of the envelope and an unknown dispersion. This algorithm is found to be not much less efficient, in terms of information loss, than detection with the noise dispersion known. Figures 2; references 6: 4 Russian; 2 Western.

USSR

UDC 621.396.96:621.391.828

TRANSFER FUNCTION OF A RADIO RELAY FILTER IN A SYSTEM WITH RETRANSMISSION OF RADIO SIGNALS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24, No 3, Mar 79 pp 511-519 manuscript received 5 Apr 76; after revision, 9 Feb 78

IVANTSEVICH, N.V. and MOLCHANOV, YU.V.

[Abstract] Optimum signal filtration from interference in radio relay systems can be achieved, if the retransmission power is large, by means of a relay filter with a high gain and a passband much wider than the signal spectrum so that the receiver becomes in effect a matched filter. However, this is difficult in the case of limited retransmission power, as in satellite radio communication systems. Here the problem of properly distributing the filter characteristics between a linear relay and a receiver under such conditions is considered theoretically. First the equation of the optimum transfer function is derived for the relay filter under conditions of limited retransmission power in the general case. Then both the relay

filter and the receiver filter are optimized together, in terms of the ratio of their respective transfer functions, for a maximum signal-to-noise ratio at the site of reception in two extreme cases: zero noise at either the relay input or at the receiver input. It is deduced from this that, under conditions of limited retransmission power, neither of the two filters can be a matched one and neither of them has a passband wider than the signal spectrum. The criterion of maximum signal-to-noise ratio, moreover, determines only the amplitude-phase characteristic of the relay filter and leaves its phase-frequency characteristic entirely arbitrary. Figures 4; references 7: 6 Russian, 1 Western.

USSR

UDC 621.396.962.3:621.376.56

#### USE OF SINGER CODES IN MULTIBEAM DISTANCE MEASURING CHANNELS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24, No 3, Mar 79 pp 520-525 manuscript received 15 Oct 76

IPATOV, V.P., KOLOMENSKIY, YU.A. and KORNIYEVSKIY, V.I.

[Abstract] Binary signals with a uniform periodic autocorrelation function (normalized) background are considered for measuring the delay of a continuous periodic FM signal in multibeam distance measuring channels with a wide dynamic range, inasmuch as side lobes can in this case be easily filtered out. A comparative analysis of all seven known classes of such signals indicates that with Singer codes with  $q=3$  the signal-to-noise ratio decreases least, by only 0.51 dB, as a result of side-lobe suppression (with  $q=2$  it already decreases by 3 dB). Singer codes with  $q=3$ , including the only known one with a zero periodic autocorrelation function background, namely  $-1, -1, -1, 1$  corresponding to the  $(4, 1, 0)$  difference class  $D_0 = \{3\}$ , thus ensure almost ideal compression of binary periodic FM signals. The rule for generating such a code is shown, as well as the schematic diagram of a code generator and the design of the optimum filter operating with it. Figures 1; tables 3; references 6: 3 Russian, 3 Western.

USSR

#### ULTRA-SHORT WAVE TRANSVERTER

Moscow RADIO, No 1, Jan 79, pp 13-16 (plus unnumbered insert)

ZHUTYAYEV, S. (UW3FL), Master of Sport, USSR. Moscow

[Abstract] The paper describes in detail the circuitry and construction of an ultra-short wave transverter for the 144--144.5 MHz range, which is intended for operation together with a short-wave transceiver for the 21--21.5 or 28--28.5 MHz range. The output power of the transverter in a transmitting regime is 5 W (with a level of power available from the transceiver of approximately 1 mW). The noise factor in a receiving regime amounts to 2--2.5  $kT_0$  (with a noise factor of the receiving part of the short-wave transceiver not more than 10--15  $kT_0$ ). The transverter has a linear transmitting channel (trakt), i.e., it assures linear dependence between the amplitude signal fed from the short-wave transceiver, and the amplitude of the output signal (in the 144 MHz band). Figures: 7

USSR

#### NEW TYPES OF CABLES FOR RURAL TELEPHONE NETWORKS

Moscow VESTNIK SVYAZI in Russian, No 3, Mar 79 pp 31-33

PARFENOV, YU.A., candidate in technical sciences, head of laboratory, and TSALIOVICH, A.B., candidate in technical sciences, senior scientist, Leningrad Division of the Central Scientific Research Institute of Communication

[Abstract] At the present time three basic types of cables are used in rural telephone networks: 1.2 mm single-quad high-frequency KSPP, 1.2 mm single-pair wire-radio PRPPM, and 0.4, 0.5, 0.7 mm local-telephone TPP. Their failure rate is still high, averaging 5 a year per 100 km of cable length in the case of KSPP, moisture being the major cause. New grades of cables have been developed whose main features are hydrophobic core filler, a polyethylene insulation, a smaller diameter of copper conductors and the use of aluminum conductors. They are: KSPPZ 1x4x1.2 (polyethylene sheath) and KSPPEZ 1x4x1.2 (steel-tape armor inside polyethylene protective jacket, both hermetically sealed, and TPZPZ (aluminum-tape shielding inside polyethylene sheath), TPPZP (polyethylene sheath, single-layer steel-tape armor inside polyethylene protective jacket),

TPEPZBP (aluminum-tape shielding, double-layer steel-tape armor inside polyethylene protective jacket). Their electrical characteristics are equivalent to those of existing cables, as specified by appropriate norms. Their use should contribute to a higher reliability and better overall economy. Figures 4; tables 2.

USSR

#### A NEW RATE SCHEDULE FOR SERVICES OF COMMUNICATION ENTERPRISES

Moscow VESTNIK SVYAZI in Russian, No 3, Mar 79 pp 39-40

SRAPIONOV, O.S., doctor of economic sciences, deputy chief of MONIIS (Moscow Branch, Scientific-Research Institute of Communication)

[Abstract] Proper economic planning and production-technical management of communication enterprises require that rates be periodically reviewed and accurately justified. The present rate schedule dates back to 1972 and is based on 1968 costs. A new one is planned for 1979, taking into account the greater complexity of this industry as well as the need for more price differentiation from the producer's standpoint and more rate consolidation from the users' standpoint. The principal criteria for establishment of an objective rate schedule should be the type of service and the destination zone. Further criteria should be technical trend and progress in a particular mode of communication, followed by service innovations. Typical examples are postal service and urban telephone networks, the latter to be treated separately from regional telephone networks and to include wire-radio systems such as the "Altay." Most difficult seems to be setting rates for line-cable equipment servicing, because here the relation between rising production volume and rising real production costs is particularly critical. A general rule must be remembered that, regardless of the rate schedule, the total revenue of the entire communication complex should always correspond to the total services provided, because usually an increase of services in one branch may be accompanied by an equivalent decrease of services in other branches.

USSR

# STANDARDIZATION OF INDUSTRIAL RADIO INTERFERENCE

Moscow VESTNIK SVYAZI in Russian, No 4, Apr 79, pp 18-19

GATOVA, A.B., staff member, LONIIR (expansion unknown)

[ABSTRACT] In the USSR development was completed in 1971 on the basic standards with respect to radio interference: terms and definitions, general methods of testing for sources of radio interference and the technical requirements on measurers of radio interference. Starting in 1972, the growth of standardization in the field of industrial radio interference proceeded as follows: development of standards for norms and methods of testing specific groups of devices--sources of radio interference on the basis of the "All-Union Norms for Permissible Industrial Radio Interference"; development of SEV (Council for Mutual Economic Aid) standards; unified standards for USSR and GDR. In 1972 standards were approved on radio interference from devices with internal-combustion engines. Standards on radio interference from illuminants with luminescent lamps were approved in 1975. Standards on radio interference from electric power transmission lines (LEP), approved in 1976, regulate the field intensity of radio interference from LEP and electrical substations in the frequency range 0.15--1000 MHz. The standard for radio interference created by television and radio broadcasting receivers was approved in 1977. Considerable work was accomplished in 1976-1978 on creating SEV standards. Brief descriptions are given with respect to the above standards.

USSR

UDC 534.232.082.74

**RADIATIVE LOSSES IN A SURFACE-ACOUSTIC-WAVE RESONATOR CAVITY FORMED BY  
INTERDIGITAL REFLECTORS**

Moscow **RADIOTEKHNIKA I ELEKTRONIKA** in Russian Vol 24, No 3, Mar 79 pp  
488-497 manuscript received 20 Jan 78

GUREVICH, G.L., SANDLER, M.S. and SVESHNIKOV, B.V.

[Abstract] Radiative losses limit the Q-factor and thus the performance of surface-acoustic-wave devices. Here a resonator cavity formed by two simple identical interdigital reflectors in a symmetrical configuration is considered and the radiative losses caused by diffraction and deflection of the beam are calculated. In the general case losses caused by both occur but are not additive, while predominance of diffraction or deflection respectively characterizes an extreme case and depends on the cavity geometry. The results of the analysis are then extended to reflectors with apodization of digits, namely where the length of digits, i.e., the overlap of heteropolar electrodes within each increases symmetrically in the outward direction. The reflection coefficient, which characterizes the losses, is now a piecewise-linear function approaching a polynomial function of the beam apodization as the number of digits becomes larger. It is found to be smaller in both cases of diffraction and deflection than without apodization. This suggests a way to reduce radiative losses and to increase the Q-factor of a Surface-Acoustic-Wave resonator cavity. Figures 5; references 12: 3 Russian, 9 Western.

USSR

UDC 535.417.2:621.385.69

**EFFECT OF A DOUBLE DIFFRACTION GRATING AS A PHASE INHOMOGENEITY ON THE  
CHARACTERISTICS OF AN OPEN RESONATOR CAVITY**

Moscow **RADIOTEKHNIKA I ELEKTRONIKA** in Russian Vol 24, No 3, Mar 79 pp 641-643  
manuscript received 13 Jun 77

VERTIY, A.A., MOKRYY, V.M., MOROZ, YE.YE., POPENKO, N.A., SOROKA, A.S. and  
SHKODIN, V.I.

[Abstract] A diffraction radiation generator (GDI) as a source of coherent monochromatic millimeter or submillimeter waves is characterized by a rather high stability. In order to increase its efficiency as a heterodyne generator, however, it is necessary to make the interaction between the electron beam and the field inside the resonator cavity more efficient.

Neither widening nor narrowing the electron beam provides a solution to the problem. Therefore, the resonator cavity is studied. Here an open resonator cavity with a double diffraction grating, a reflecting one under a transmitting one, and with two mirrors is considered. An analysis of the field distribution indicates that the field distortion caused by the phase inhomogeneity in the form of such a double diffraction grating can be compensated by high-Q natural oscillations in the resonator cavity and can thus be achieved by proper relative shifting of the gratings and the mirrors along the cavity axis. Figures 4; references: 4 Russian.

USSR

UDC 621.372

#### SELF-ADJUSTING ACTIVE LOW-PASS FILTER

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian, No 1, Jan-Feb 1979, pp 123-126 manuscript received 24 Aug 77

TARASOV, A.V. and TARASOVA, L.P.

[Abstract] A number of works in the literature describe the circuits of rearranged active filters. However, problems of self-adjusting filters and filtering systems are not considered in these works. Each of the known filters has various shortcomings which hinder its use in a system, where a fairly simple filter is required, tunable at the first harmonic of the signal in question and assuring high suppression of short harmonics. The method of tuning the filter and their control circuit must make it possible to connect up filters of other types without further complication of the control circuit. Filters which satisfy all these requirements are described. A model of a self-adjusting low-pass filter of the sixth order which operated stably under laboratory conditions assured a reduction of the non-linear harmonic distortion coefficient from 100 percent at the input to 0.6 at the output in all the frequency range 300 ÷ 800 Hz. Figures 4; references 5: 2 Russian; 3 Western.

USSR

UDC 621.372.8.049.75

#### INVESTIGATION OF STRIP-LINE L-NETWORK MATCHING CIRCUITS

Moscow RADIOTEKHNIKA in Russian Vol 33, No 12, Dec 78 pp 57-62 manuscript received 19 Apr 78

TOLSTOY, A. I.

[Abstract] Strip-line L-network matching circuits used in transistorized microwave amplifiers are studied on the basis of the TEM approximation, and limits of applicability of this method are recommended on the basis of experiments. It is shown that circuit analysis can be reduced to the solution of a system of equations in five unknowns. Because such a system either has no solutions or an infinite number of solutions, the analysis is restricted to two special cases: 1) All parameters of the matching circuit are known and it is required to determine the reflectance; and 2) The capacitance of the isolation capacitor and characteristic impedances of the strip lines are known and it is necessary to determine the lengths of the strip lines that ensure a predetermined reflectance. A method of calculation is proposed that gives satisfactory agreement with experimental data. The given technique for designing the topology of strip-line L-structures is inaccurate only when the shorted loop is not as long as it is wide, or if the width of the strip lines is comparable with a wavelength on the working frequency. With these limitations, the method can be recommended for designing hybrid microwave IC's. Figures 3; tables 3; references: 4 Russian.

USSR

UDC 621.372.822

#### BAND PROPERTIES OF A RECTANGULAR CORRUGATED WAVEGUIDE

Moscow RADIOTEKHNIKA in Russian Vol 33, No 12, Dec 78 pp 86-88 manuscript received 27 Feb 78

GETMANTSEVA, T. N., RADIONOV, A. A. and RAYEVSKIY, S. B.

[Abstract] An investigation is made of the band properties of rectangular corrugated waveguides with the corrugation encircling the entire perimeter, and an analysis is made of the possibilities for maximizing the working bandwidth on the fundamental wave in such devices. Characteristic equations are derived for calculating the critical frequencies of  $H_{10}$ ,  $H_{20}$  and  $H_{01}$  waves in corrugated rectangular waveguide, and it is shown that the results

approach the values for an analogous smooth waveguide as the depth of the corrugation approaches zero. It is found that the critical frequencies of all modes decrease with an increase in the depth of the corrugation as the cross section remains constant. The critical frequencies of waves in the corrugated waveguide also decrease with an increase in the ratio of the narrow to the wide wall when the depth of the corrugation remains unchanged. Both these variations are equivalent to an increase in the dimensions of the cross section of the waveguide. The critical frequencies of the  $H_{01}$  wave decrease more strongly than those of the  $H_{10}$  and  $H_{20}$  waves, resulting in an exchange of frequencies of the  $H_{20}$  and  $H_{01}$  modes at certain values of the geometric parameters. To maximize the bandwidth, the waveguide parameters must be chosen so that they lie below the curve corresponding to the exchange of critical frequencies. The characteristic equations used for the calculations are confirmed within 1 percent by experiment. Figures 3; tables 1; references 4: 3 Russian; 1 Western.

USSR

UDC 621.372.852

#### WAVEGUIDE WAVE TRAP

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian, No 1, Jan-Feb 1979, pp 120-122 manuscript received 8 Jul 77

KOVALEV, N.F., REZNIKOV, M.G. and SLUTSKER, YA.Z. Institute of Applied Physics, Ukrainian Academy of Sciences, Gor'kiy

[Abstract] During investigation of the process of scattering of electromagnetic waves by plasma fluctuations, the necessity arises for the use of a band-elimination filter, which possesses a high level of suppression of a signal ( $>100$  dB) in the band of frequencies from several percents to tenths of a percent. Tuned filters, in particular filters in the form of a system of connected resonators, do not as a rule have the necessary parameters. In the centimeter and millimeter wave band, filters with the required properties can be rather simply realized in the form of a hollow metal waveguide with a small depth of the corrugation of the lateral surface. In the present work experimental filters of two types were made on the basis of single-mode rectangular waveguides (operating wave  $H_{10}$ ) at a wavelength of  $\sim 8$  mm. The filter of the first type with a central frequency of 38.5 GHz was designed for a maximum level of suppression of 110 dB in an attenuation band of 10 percent. The filter was made by the method of electrolytic deposition of copper on a Duralumin mandrel which later was etched. The wave trap of the second type, designed for a maximum level of suppression of 135 dB in a 2.5 percent band with a central frequency of 38.65 GHz was a section of a waveguide. Holes with identical diameters were drilled with respect to the axis of the wide wall of the waveguide section. The authors thank A.V. Kostrov for assistance in the work and for critical comments on the data of the paper. Figures 3; tables 1; references: 7 Russian.

USSR

UDC 621.317.725

## TYPE F4833 INTEGRATING ANALOG-TO-DIGITAL CONVERTER

Moscow PRIBORY I SISTEMY UPRAVLENIYA, No 2, 1979, pp 20-22

GORELIKOV, N.I., candidate in technical sciences, KOZITSKIY, I.D., KOCHAN, V.V., MATVIIV, V.I. and RYLIK, M.G., engineers

[Abstract] An algorithm of weighted two-cycle (dvukhtaktnyy) integration is described, which was used in development at the SKB MP (Special Design Office. MP [expansion unknown]), L'vov, of a Type F4833 analog-to-digital converter of class 0.05/0.03. A photograph of its exterior and a block diagram of the F4833 are shown, and the principles of operation of this highly-stable, highly-sensitive converter are discussed. The F4833, unlike other integrating instruments (pribor) manufactured in the USSR, assures a conversion time of 40 msec during operation in a multichannel system with a commutator. The suppression coefficient for noise of normal form, not synchronous with the network with respect to frequency, in the 48--52 Hz frequency band, is not less than 50--60 dB and of general form not less than 100-120 dB. Figures 5; references: 2 Russian.

USSR

UDC 621.374.4

## CALCULATING THE ENERGY CHARACTERISTICS OF A TRANSISTORIZED MICROWAVE FREQUENCY MULTIPLIER WITH FEEDBACK

MOSCOW RADIOTEKHNIKA in Russian Vol 33, No 12, Dec 78 pp 34-39 manuscript received 1 Sep 77

SOLOSHEK, L. K.

[Abstract] Engineering formulas are derived for calculating the energy parameters of a transistorized microwave frequency multiplier with feedback--output power and transmission factor--and recommendations are made on choosing the transistor type and its mode of operation. Active nonlinearity of the emitter junction (cutoff of the current-voltage characteristic) is taken as the source of harmonics. The nonlinearity of the collector junction and related parametric effects are disregarded. It is shown that the maximum output power and transmission factor over a wide frequency range correspond to cutoff angles of about  $75^\circ$  for a frequency doubler, and  $55^\circ$  for a frequency tripler. With an increasing multiplication factor the transmission factor drops rapidly, and therefore such frequency multipliers are superior to analogous devices using diodes with charge accumulation only as doublers or triplers. Figures 6, references: 2 Russian.

USSR

UDC 681.142.621.001.2

#### HIGH-SPEED ANALOG-TO-DIGITAL CONVERTER WITH LOGARITHMIC SCALE

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian, No 1, Jan-Feb 1979, pp 79-82 manuscript received 26 Apr 77

BELONOSOV, YU.I. and YAMNYY, V.YE. Belorussian State University, Minsk.

[Abstract] An analog-to-digital converter is described which makes it possible to convert positive polarity signals in all the range from 0.18 mV to 3.5 V, with a fixed level of balancing. The magnitude of the balancing level is not more than plus or minus 0.2 V. The conversion time is 1 microsec with a constant relative error of  $\sim 2.6$  percent. Null tracking circuits (controlled generators) are used in the analog-to-digital converter in order to decrease the temperature in the device. The circuits establish null at the output of all the units entering into the channel for transmission of the analog signal, during its absence at the input of the device. The tracking circuit is disconnected before delivery of the signal in question to the input of the analog-to-digital converter. Figures 2; references: 8 Russian.

USSR

UDC 681.325.3

#### HIGH-SPEED ANALOG-TO-DIGITAL CONVERTER

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian, No 1, Jan-Feb 1979, pp 77-79 manuscript received 20 Sep 77

GOLOVANOV, A.A., ZYKOV, YU.V., MIL'CHAKOV, V.A. and CHURKIN, V.V. Kirov Polytechnical Institute

[Abstract] As a rule, in-line processing of information requires a minimum time of analog-to-digital signals. During this, it is often found that it is sufficient to have a digital equivalent signal of  $5 \div 6$  binary bits. The present paper describes an analog-to-digital converter which transposes an input signal, varying in the limits from 0 to + 5 V, into a 5-bit binary code. The attainable frequency of discretization of the input signal is 20 MHz. The converter operates on the principle of parallel coding, which assures a high-speed response, and contains the following units: input device, shaper of reference voltages, set of comparators, trigger memory and code converter. Figures 2; references: 1 Western.

USSR

UDC 537.876.23:551.510.5

GREEN'S FUNCTION FOR SCALAR MICROWAVES IN A MEDIUM WITH STRONG RANDOM  
INHOMOGENEITIES

Moscow RADIOTEKNIKA I ELEKTRONIKA in Russian Vol 24, No 3, Mar 79 pp 615-617  
manuscript received 5 Nov 77

ARMAND, N.A. and SEKISTOV, V.N.

[Abstract] Propagation of scalar coherent microwaves through a medium with strong random inhomogeneities is analyzed with the aid of the nonlinear Kreutchnan approximation of the mass operator and on the basis of the Dyson equation for the scalar Green function. Calculations for short waves  $k_0 r \gg 1$  ( $k_0$  denoting the wave number in a vacuum and  $r$  denoting the correlation radius of inhomogeneities in the medium) and a very small dispersion of inhomogeneities reveal spatial beats of the Green function, because of the existence here of two waves with different propagation constants, a purely algebraic extinction rather than usual exponential attenuation of the field with increasing distance in space. Turbulent clearance of the medium, when the dispersion of inhomogeneities is sufficiently large, can result in a somewhat higher intensity of the coherent field. The authors thank V.I. Tatarskiy for discussion of the work. Figures 2; references 6: 4 Russian, 2 Western.

USSR

UDC 621.371:537.877

INFLUENCE THAT NONLINEAR PARAMETERS OF THE MEDIUM HAVE ON THE PROPAGATION  
AND REFLECTION OF ELECTROMAGNETIC WAVES

Moscow RADIOTEKNIKA in Russian Vol 33, No 12, Dec 78 pp 62-65 manuscript  
received 15 May 77

VOL'MAN, V. I. and VIL'DAVSKIY, V. YU.

[Abstract] Analytical expressions are derived that describe the structure of the electromagnetic field in a nonlinear medium, and an examination is made of the process of normal incidence of an electromagnetic wave on the interface between two media, one of which is nonlinear. Relations are found between the amplitudes and powers of the incident, reflected and refracted waves on different harmonics, and computer calculations give numerical results that are presented as graphs. One important result of the numerical calculations is an estimate of the nonlinear effects that arise when electromagnetic waves are reflected from the surface of the earth.

The fact that metal structure may be near antennas on the earth's surface allows us to consider the earth as a nonlinear medium. Nonlinear effects can also show up caused by natural ferromagnetic inclusions in the ground. When the power flux of the incident wave is of the order of  $100 \text{ W/m}^2$ , the relative level of the third harmonic is -65 dB, and an increase in the intensity of irradiation leads to a square-law increase in off-band emission, which reaches -25 dB at an irradiation power of  $10,000 \text{ W/m}^2$  (modern requirements permit a range from -100 to -80 dB). Calculations show that this figure is exceeded at irradiation power fluxes as low as  $10 \text{ W/m}^2$ . Figures 2, references 2: 1 Russian; 1 Western.

USSR

### THIRD INTERNATIONAL SYMPOSIUM AND TECHNICAL EXHIBITION ON ELECTROMAGNETIC COMPATIBILITY

Moscow RADIOTEKNIKA in Russian Vol 33, No 12, Dec 78 p 26

[Abstract] The next International Symposium on Electromagnetic Compatibility (EMC) is to be held in Rotterdam 1-3 May 1979. Taking part in preparation and administration of the symposium are the International Radio Scientific Union (IRSU), the International Special Committee on Radio Interference (CISPR), the Union of Societies of Electrical Engineers of Western Europe, the Polish Association of Electrical Engineers (SEP), the Eighth Section and Group on EMC of the Institute of Electrical and Electronics Engineers (IEEE), and Committee AE-4 on EMC (Electromagnetic Compatibility) of the American Society of Automotive Engineers (SAE). The following topics will be discussed: social and economic impact of EMC; electromagnetic pollution, its control and verification of compliance with regulations; spectrum economy and control; national and international cooperation in the field of EMC; interference immunity of receivers, electronic, analog and digital systems; EMC in electric power, vehicle and communications devices; danger from lack of EMC in vital safety systems; compatibility in medical electronic equipment; biological effect of rf energy; interference propagation, relation between source and receiver; influence of nuclear electromagnetic pulses; legislation, norms, standards and technical specifications; measurement methods and equipment; computers in prediction and analysis of EMC; design of compatible equipment, methods and means of interference suppression. There is also to be an exhibition on interference-suppressing equipment, shielded and anechoic chambers, measurement equipment and shielding. English will be the official language.

USSR

UDC 534.143

DIGITAL MEASURER OF LOSSES IN MECHANICAL OSCILLATING SYSTEMS

Moscow PRIBORY I SISTEMY UPRAVLENIYA, No 2, 1979, pp 28-29

BUNYATOV, G.S. and SKOBLO, V.Z., engineers

[Abstract] In a number of cases, measurement of the attenuation of oscillating systems must be performed with a constant amplitude of the oscillations. A similar problem occurs during measurement by vibrator converters of viscosity, density and consumption of liquids or gases, as well as during study of internal friction, depending on the amplitude. The present paper describes a measurer, operating in accordance with the principle of excitation and stabilization of auto-oscillations with simultaneous conversion of the magnitude of attenuation into a digital signal. High precision of measurement and the possibility of recording attenuation by standard digital devices are assured. The technical characteristics of the measurer are:

Frequency range in Hz--300-10,000

Irregularity of frequency characteristic in dB--plus or minus 3

Maximum phase shift in radians--plus or minus 0.07

Instability of transmission coefficient of primary and supplementary channels of a self-excited oscillator in percent--plus or minus 0.1

Comparison circuit in percent

Instability of levels of comparison--0.2

Error of setting of comparison levels--0.2

Switching time of antiphased circuits in nanosec--500

In the conversion range  $\lambda_{\max} \lambda_{\min} = 10$ , the measurer described assures a deviation from linearity of not more than 0.2 percent and an error of measurement of attenuation with nonlinearity taken into account of not more than plus or minus 0.15 percent. The measurer has been used during investigations of vibration viscometers. Figures 2.

USSR

UDC 543.082

# GENERAL-PURPOSE SYSTEM FOR RECORDING SPECTRA IN GRAPHIC AND DIGITAL FORM

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian, No 1, Jan-Feb 1979,  
p 262 manuscript received 27 Sep 77

TATARINOV, S.S., EKZARKHO, V.M. and FINKEL', A.G.

[Abstract] The system is intended for recording of spectra, simultaneously or optionally, by a digit-printing machine, perforator and self-printing potentiometer. Operation is possible with a spectrophotometer of any type which has an analog signal in the form of a voltage proportional to the magnitude being measured. Operation is possible in real time and in a "rigid" regime of connection with a range of wave numbers without introduction of changes in the working scheme of the device and minimum interference in the scanning system. The technical characteristics of the system are given and a photograph of the system's exterior is shown. Figures 1.

USSR

UDC 543.422.23

# ANALOG CALCULATOR OF FOURIER TRANSFORMATIONS FOR PULSE NUCLEAR MAGNETIC RESONANCE EXPERIMENTS

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian, No 1, Jan-Feb 1979,  
pp 130-133 manuscript received 1 Aug 77

SUKHOVSKIY, A.A. Institute of Physics, Siberian Department of the USSR Academy of Sciences

[Abstract] At present, pulse methods of nuclear magnetic resonance (NMR) which make it possible in many instances to increase the sensitivity considerably, or to reduce the time of the experiment have acquired wide dissemination during various investigations of liquids and solids. The absorption spectrum of NMR is obtained during this by a Fourier transformation (FT) of the decrease of free induction (DFI) which is observed after a radio frequency pulse. Ordinarily, in order to conduct a Fourier transformation, specialized electronic computers with an appropriate set of programs are used. However, the possibility of using analog devices, combined with a digital storage which serves for recording and storage of DFI signals, for Fourier transformations is attractive. The advantages of an analog FT are the low cost, the simplicity of exploitation and the substantially increased resolution in comparison with a digital FT with a similar volume of memory. The present paper describes such a device for an analog Fourier transformation, which is characterized by simplicity

of the circuit. The device makes it possible without use of an electronic computer to realize the high sensitivity characteristic of pulse methods of NMR. The device is used for recording the spectrum of the nuclear magnetic resonance of  $^{13}\text{C}$  in solids by the method of double resonance of  $^{13}\text{C}$ -- $^1\text{H}$  with cross polarization of the nuclei of carbon by protons. Devices for analog FT similar to the one described in the paper can be used for registration of the NMR of unusual spins in solids, in multipulse experiments with respect to narrowing of lines and other cases when an especially high resolution (better than one Hz) is not required or is inaccessible for physical reasons. Figures 2; references 7: 3 Russian; 4 Western.

USSR

UDC 621.3.072.073:621.3.08

#### MAGNETIC FLUX STABILIZER

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian, No 1, Jan-Feb 1979, pp 139-141 manuscript received 27 Jul 77

KIYANOVSKIY, YE.V. and VARENIK, A.P. Special Design Office, Institute of Organic Chemistry, USSR Academy of Sciences, Moscow

[Abstract] In contemporary high-resolution radiospectrometers of magnetic nuclear resonance (MNR), a magnetic flux stabilizer (MFS) is a component of the system of stabilization of the resonance conditions. However, in native radiospectrometers, the MFS have not found wide use because of the poor phase-frequency characteristics of the photogalvanometric amplifier included in the closed loop of negative feedback. This leads to self-excitation of stabilization. The authors of the present paper developed the MFS of a radiospectrometer of MNR, based on 2 UVT-21-75 high-precision operational amplifier, which has a high sensitivity, an increased stability and good phase-frequency characteristics. The MFS consists of detector and control coils located on the pole piece of the magnet, between which is connected the electrical block, the principal circuit of which is shown in the work. The conditions of observation of the MNR can be held with a precision of  $4 \cdot 10^{-8}$ . Figures 1; references: 2 Russian, 1 Western.

## USE OF SPECIAL HEAT-RESISTANT CABLES IN INDUCTIVE LEVEL GAUGES

Moscow PRIBORY I SISTEMY UPRAVLENIYA, No 2, 1979, pp 17-18

ANISIMOV, N.S., engineer, KOZLOV, M.G. and SHMIGORA, V.N., candidates in technical sciences

[Abstract] The longevity and limitations of the operational parameters of the pickups (datchik) of inductive level gauges basically depends on the properties of the conductors from which the winding of the pickup coils is made. Interest has been shown by many investigators in the prospects for use in level gauges for molten metals, of KTMS high-temperature cables with metal sheathing and magnesian insulation intended for operation at temperatures up to 800° C under conditions of radioactive radiation. The principal reasons for temperature errors in known designs of inductive level pickups from KTMS cable are connected, as is shown in the present paper, with the significant line capacitance of the system of cores--core and core--sheathing inherent to this cable, and the high line resistance of the core. Consequently, in inductive pickups fairly large parasitic components (not depending on the controlled parameter) of the voltage of the secondary windings appear, and a nonuniform distribution of the magnetic flux density along the coils of the pickups is observed, in connection with which the relative dimension of the useful signal substantially decreases, and the effect of the temperature increases. In the paper, using as an example an analog inductive level gauge with an inductive type pickup of KTMS cable, the effect of line capacitance and resistance on the temperature is considered. An experimental confirmation of the effect of the capacitance component is shown in graphical form. The considerations cited are also correct at the time when, independently of the type of cable or the conductors which are used for the windings of the pickup, the value of the distributed capacitance between the primary and secondary windings is sufficiently large. Figures 2; references: 2 Russian.

## EQUIPMENT FOR MEASUREMENT OF HALL EMF AND MAGNETORESISTANCE OF LOW-RESISTANCE MATERIALS BY THE AMPLITUDE MODULATION METHOD

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian, No 1, Jan-Feb 1979, pp 215-217 manuscript received 2 Nov 77

KILLA, YE.V. and LUK'YANOVA, L.N. Physico-Technical Institute, USSR Academy of Sciences, Leningrad

[Abstract] A block diagram is shown and a description given of a device for measuring the Hall emf, the magnetoresistance and the resistance of low-resistance materials. In contrast to units described in a number of works in the literature, the proposed device is provided with a channel of negative feedback which carries out compensation of a carrier frequency signal at the input of the measuring system. Use of the negative feedback channel assures an optimum choice of the modulation depth and makes it possible to avoid distortions of the amplitude of the signal being modulated and overload of the synchronous detector. This is particularly important during measurement of magnetoresistance because the modulating signal is small in comparison with the carrier signal. During measurement of the Hall emf, the carrier frequency signal, proportional to the voltage of the nonequipotentiality of the Hall contact, is small and does not require compensation. As an example, the temperature dependences are presented of the specific resistance  $\rho_{11}$ , the Hall coefficient  $\rho_{123}$  and the magnetoresistance  $\rho_{1133}$  for a  $\text{Bi}_2\text{Te}_{2.7}\text{Se}_{0.3}$  specimen in the temperature interval 77 - 300 K. Figures 2; references 8: 7 Russian; 1 Western.

USSR

UDC 621.317.755

#### HIGH-SPEED OSCILLOGRAPH WITH DIGITAL OUTPUT

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian, No 1, Jan-Feb 1979,  
p 264 manuscript received 12 Dec 77

PAKHOMOV, L.M. and CHERKASOV, A.V.

[Abstract] The instrument is intended for collection and processing of data in measuring systems, among them systems with the use of an electronic computer. The function of the oscillograph is the intermediate storage of data, their analog-to-digital conversion, transfer into the permanent storage with a speed suitable for the electronic computer. The principal action of the oscillograph involves storage of a curve in an analog form on the target potentiometer and the subsequent slow readout of the coordinates of the potential relief. The technical characteristics of the system are given and a photograph of the system in exterior is shown. Figures 1.

USSR

UDC 621.317.761

#### DISCRETE FREQUENCY DISCRIMINATOR BASED ON MICROCIRCUITS

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian, No 1, Jan-Feb 1979,  
pp 116-118. First variation received 17 Aug 77; received, 24 Apr 78

ANDREYEV, M.I.

[Abstract] The paper describes a discrete frequency discriminator based on series K155 microcircuits and constructed according to the principle of a periodic numeration of the number of pulses filling a length of time, which equals the difference of duration of time intervals containing an identical number of periods of reference and monitored signals. The discrete frequency discriminator makes it possible with high precision to measure small deviations of frequency of the monitored signal. For concrete individual applications, the values of the coefficients of division of the measuring device and the nominal frequency of the reference generator can be varied, but at the same time it is necessary that the cyclicity of changes and the signal spectrum be in accordance with the theorem of V.A. Kotelnikov. Figures 2; references: 2 Russian.

USE OF SPREADING RESISTANCE METHOD FOR CHECKING OF SPECIFIC RESISTANCE  
AND THICKNESS OF EPITAXIAL LAYERS OF SEMICONDUCTOR MATERIALS

Moscow PRIBORY I TEKNIKA EKSPERIMENTA in Russian, No 1, Jan-Feb 1979,  
pp 218-220 manuscript received 4 Oct 77

MALYSHEV, V.A.

[Abstract] The paper describes work which demonstrates the possibility of nondestructive checking of the specific resistance  $\rho$  at the surface of an epitaxial layer and its thickness  $d$ , by conducting a series of measurements of the spreading resistance  $R$ , made by a measuring sound with various contact areas. A relationship is found which makes it possible to organize in practice a number of procedures for checking both the specific resistance at the surface of the epitaxial layer and its distribution with respect to the thickness of the doping profile. Use for measurements of at least two sounds with differing contact radii assures exclusion of detection of a different family of surface layers, e.g., oxides of silicon. Tables 2; references 5: 3 Russian; 2 Western.

## ANALOG-DIGITAL DECIBELMETER

Moscow PRIBORY I SISTEMY UPRAVLENIYA, No 2, 1979, pp 29-30

TSIDELKO, V.D., TESLENKO, V.A., candidates in technical sciences, and  
GLADKOV, A.M., engineers

[Abstract] At the Kiev Order of Lenin Polytechnical Institute the authors developed and made ready an operating model of an analog decibelmeter which can be used as a standardized output device in measurers of the voltage level in selective voltmeters and other communication measuring equipment. The principal characteristics of this decibelmeter are: 1) Switching of external attenuator is produced with 20 dB steps in the  $+20 \div 120$  dB range up to the entry of input direct-current voltage in the zone  $-20 \div -10$  dB (the level of 0 dB corresponds to 0.7746 V); 2) For indication of the results of transformation, five decimal digits (highest order incomplete) are used, during which the value of the transformation limit is brought to the two highest orders of them, and to the three lowest order, the result of the transformation in the 20 dB range; 3) The absolute maximum error of transformation is plus or minus 0.01 dB which corresponds to the maximum relative error of plus or minus 0.1 percent in the 20 dB range at the interval of operating temperatures of  $5-40^{\circ}\text{C}$ ; and 4) The transformation time is 50 msec. Three operating conditions are provided in the instrument: one time, automatic and averaging out of tens of measurements. All the units of the decibelmeter are produced in standard cassettes, which can be incorporated in other instruments and measuring systems. Figures 1; references: 2 Russian.

USSR

UDC 621.3.062.8

# HIGH-SPEED KEY FOR HIGH-FREQUENCY SIGNALS

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian, No 1, Jan-Feb 1979,  
pp 133-115 manuscript received 24 Aug 77

GARIBOV, M.A., GUSEYNOV, N.L., KULIYEV, F.N., MAMEDOV, S.M. and SPIRIN,  
A.G.

[Abstract] Methods are described for construction of hybrid integrated circuits for high-speed high-frequency analog keys (klyuch) based on bipolar transistors with a high decoupling between the input and output. The principal circuit is presented of one of the devices constructed on the basis of the methods described. For an increase of the efficiency coefficient, KT354B transistors with a small capacitance of the p-n junction ( $\leq 1.2$  pF) were used as the elements of the series keys; and in the parallel key, a KT307G transistor with a large capacitance of the p-n junction ( $3 \div 5$  pF). The control circuit of the key was constructed on the base of a current switch which made it possible to reduce the switching time to 70 nanosec. The amplitude of the switching surges (vybros) in the circuit does not exceed 30 mV and their duration is 15 nanosec. At a frequency of 100 MHz, the efficiency coefficient  $\geq 50$  dB. The lower limit of the frequency range is limited by the magnitudes of the junction capacitors. Figure 3; references: 2 Russian.

## INTEGRATED CIRCUIT OF PULSE-WIDTH TRANSDUCER AND ITS USES

Moscow PRIBORY I SISTEMY UPRAVLENIYA, No 2, 1979, pp 23 and 26

GAL'PERIN, M.V., candidate in technical sciences.

[Abstract] The paper is concerned with the creation of a multipurpose universal element for width- (time-) and pulse-frequency modulation which has sufficiently high metrological characteristics and circuitry developed according to integral technology. These requirements are satisfied by driven multivibrators with linearizing direct-current generators in circuits for recharge of time input capacitors. Examples in the form of hybrid integrated microcircuits are presented. Figures 3; tables 1; references: 3 Russian.

USSR

UDC 621.313.2

## CIRCUIT OF SYNCHRONOUS LIGHT MODULATOR

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian, No 1, Jan-Feb 1979, pp 108-109 manuscript received 18 Nov 77

YERITSYAN, G.N., MELKONYAN, R.A., NAZARYAN, YU.R. and SAAKYAN, A.A.

[Abstract] The synchronous light modulator described in this paper was used on an ultraviolet vacuum spectrograph. With its use the light pulses were disseminated into two channels. The synchrotron radiation of the Yerevan Electron Accelerator, which gives a light pulse with a 50 Hz frequency, a duration of  $\sim 9$  ns and a form close to square pulses, served as the light source. Separation was accomplished by passing of the first and reflection of the second light pulse from two in-step rotating mirrors, mounted on the axis of the system. It was found that during synchronous rotation a small variation of the phase ( $\leq 2^\circ$ ) took place with reference to the normal position. Figures 1; references: 1 Russian.

USSR

UDC 621.372.2

## CORRECTION OF FRONT OF HIGH-VOLTAGE PULSES WITH THE AID OF ELECTRICALLY EXPLODED CONDUCTORS

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian, No 1, Jan-Feb 1979, pp 101-103 manuscript received 30 May 77

AZARKEVICH, YE.I., ZAYTSEV, N.I. and KOTOV, YU.A. Scientific-Research Institute of High-Voltage Attached to Tomsk Polytechnical Institute

[Abstract] Shaping of powerful high-voltage pulses of microsecond duration at an active load, e.g., at the diode of a high-current electron accelerator, is often accomplished by the direct discharge of an Arkad'yev-Marks generator of pulse (surge) voltages [GPV]. The rise time of the pulse is determined by the inductance of the GPV which frequently is not made sufficiently small. However, with energies in the tens of kilojoules and voltages on the order of a MV, the correcting capacitors become almost cumbersome and expensive. In the present paper a method is proposed for correction of a pulse front with the aid of a current interrupter based on electrically exploded conductors. Formulas are presented for determining the optimum dimensions of the conductors. The results obtained in the work were used during the shaping of a pulse in the power supply of an electron accelerator with the parameters: capacitance during discharge, 0.3

micro-Farad; output voltage up to 450 kV; inductance of discharge circuits, 13 microHenry. Within wide limits, the generator makes it possible to control the parameters of the pulse at a load. With a large pulse energy the interruptor requires a considerably smaller expenditure on manufacturing than the corresponding capacitor. Figures 3; tables 2; references 9: 6 Russian, 3 Western.

USSR

UDC 621.373

#### HIGH-VOLTAGE MAGNETIC NANOSECOND PULSE GENERATOR

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian, No 1, Jan-Feb 1979, pp 90-92 manuscript received 14 Nov 77

PETROV, V.A., PETROV, V.A. and EBERL', U. Joint Institute of Nuclear Research, Dubna

[Abstract] High-voltage pulses with a short front and a duration of tens of nanoseconds are necessary for the supply of electron guns, streamer chambers and certain other devices. Ordinarily, such pulses are produced in generators with dischargers. The present paper describes the circuit of a generator which makes it possible to use a TGI-2500/50 thyatron as a commutator, to increase the power of a pulse, transformed in advance with the aid of a magnetic element, and to accomplish peaking of the front and shaping of the slope. Voltage drops are obtained with a duration of 3 nanosec, and an amplitude of  $\sim 250$  kV with pulses having a 6 nanosec front, a duration of  $\sim 40$  nanosec and an amplitude of 170 kV at a 200 ohm load. The authors thank L.S. Barabash and I.V. Kozhukov for assistance and helpful discussions. Figures 5; references: 3 Russian.

## NOISES IN A GUNN-DIODE AUTODYNE MIXER

Moscow RADIOTEKHNIKA in Russian Vol 33, No 12, Dec 78 pp 27-30 manuscript received 10 Feb 78

ZAYONCHKOVSKIY, A. YA. and RUCHKIN, V. G.

[Abstract] Theoretical and experimental results are given on determination of the noise factor of Gunn-diode autodyne mixers. In the theoretical analysis, the current vs. voltage curve for the Gunn diode is approximated by a piecewise-linear model. It is assumed that the noises in the autodyne mixer are due only to fluctuations in the voltage amplitude and phase of the self-oscillations that depend on the properties of the Gunn diode and the load parameters. Noises are calculated by comparing the perturbations of the function  $i_1(t)$  that are due to fluctuations in the voltage of self-oscillations with the changes in the shape of the current pulses through the diode originating as a result of the action of a sine-wave signal. The effect of frequency fluctuations on the noise characteristics of the mixer is accounted for by establishing the relation between the standard deviations of the period of the self-oscillations from the average value, and the rms values of the increments of the phase angles corresponding to the falling and rising portions of the self-oscillating current. It is shown that the noise factor for the domain-quenching mode is lower than for the mode with delay of domain formation, and in either case the calculated values are weakly dependent on the Gunn diode supply voltage. In the general case, the noise factor depends on the power of the self-oscillations, the storage factor of the self-excited oscillator circuit, the ratio between the spectral densities of fluctuations in frequency and in amplitude, and the loads on the signal frequency and on the intermediate frequency.

Experimental results for the noise factor agree satisfactorily with the theoretical values. Discrepancies between theory and experiment for the transmission factor can be explained by failure to consider the finite time of formation and extinguishing of domains in actual diode structures. The results of this study show that with appropriate selection of working conditions the noise factor of a Gunn-diode autodyne mixer can be made comparable to that of a single-contact mixer based on a point-contact diode. Figures 4, references 9: 8 Russian, 1 Western.

USSR

UDC 621.373.029.64

MICROWAVE GENERATOR WITH DIGITAL INDICATION OF THE FREQUENCY GENERATED

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian, No 1, Jan-Feb 1979,  
p 268 manuscript received 21 Sep 77

VTORUSHKIN, B.A. and GRITSENKO, A.A.

[Abstract] The generator is intended for measurements of the high-frequency parameters of microwave apparatus and the elements of microwave channels. The device consists of a microwave generator, made with Gunn diodes, and an electronic counting frequency meter. The potentiality is provided in the device for realization of frequency modulation. The technical characteristics of the device are given and a photograph of the instrument's exterior is shown. Figures 1.

USSR

UDC 621.376.22:621.396.61

RF OPERATION OF AN OSCILLATOR WITH PLATE SELF-MODULATION IN THE UNDERVOLTAGE MODE

Moscow RADIOTEKHNIKA in Russian Vol 33, No 12, Dec 78 pp 89-92 manuscript received 7 Jan 78

FRIDMAN, G. I.

[Abstract] The author analyzes the operation of an oscillator with plate self-modulation at radio frequencies in the undervoltage mode under conditions required for low-frequency plate operation in the tube. It is assumed that the first harmonic of the plate current of the driver stage is linearly modulated (according to a harmonic law). Expressions are derived for the modulation characteristics when the tube is connected in a grounded-cathode circuit and in a grounded-grid circuit. Figures 1, references 11 Russian.

USSR

UDC 621.382.2

#### SILICON SURFACE-BARRIER PHOTORECEIVERS

Leningrad FIZIKA I TEKHNIKA POLUPROVODNIKOV in Russian Vol 13, No 3, Mar 79 525-528 manuscript received 27 Jun 78; in final editing, 24 Aug 78

YUABOV, YU.M. SHCHEBIOT, U.V., ISAMUKHAMEDOVA, D.K. and TSVETKOV, A.G.  
Physico-Technical Institute imeni S.V. Starodubtsev, Uzbek Academy of Sciences, Tashkent

[Abstract] The technology of surface-barrier photoreceivers is described and their photoelectric characteristics are analyzed, on the basis of measurements with various bias voltages in the static mode and with excitation by rectangular voltage pulses. The results indicate that an Au-Si(Li) device has a photodiode structure and an ITO-Si(Li) device has a phototransistor structure. Figures 3; tables 1; references 11: 7 Russian, 4 Western.

USSR

UDC 621.383.292

#### FEU-130 PHOTOELECTRIC MULTIPLIER

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian, No 1, Jan-Feb 1979, p 271 manuscript received 2 Aug 77

DUNAYEVSKAYA, N.V., ALEKSANDROV, I.R., IVANOV, O.I., KULOV, S.K., MAKSIMOV, A.M., MAKSIMOVA, N.G., MAKEDONOVA, L.A. and STUCHINSKIY, G.V.

[Abstract] The FEI-130 photoelectric multiplier is intended for recording of super-weak fluxes in a regime of pulse counting. Use at the first dynode of an effective emitter of Gallium phosphide (with a secondary emission rate of  $20 \div 40$  at 600 eV) assures obtaining a single-electron peak in the amplitude spectrum of pulses of the photoelectric multiplier. Separation with respect to the amplitudes of the signals at the output, induced by the escape of one of two electrons from the photocathode, is also possible. The background noise during recording of a single-electron component of the signal does not exceed  $400 \text{ sec}^{-1}$  at room temperature. The region of the spectral response of the photoelectron multiplier is from 200 to 650 nm; the maximum sensitivity is located between  $400 \div 420 \text{ nm}$ . Other technical characteristics of the device are given and a photograph of the exterior of the FEU-130 is shown. Figures 1.

USSR

UDC 621.396.7

ON A METHOD OF CALCULATING THE SHIELDING PROPERTIES OF RADIO TRANSCEIVERS

Moscow RADIOTEKHNIKA in Russian Vol 33, No 12, Dec 78 pp 31-34 manuscript received 16 Nov 77

GUSEV, G. P. and KOROZA, M. I.

[Abstract] A method is examined for determining the shielding properties of electronic radio equipment, and the required effectiveness of shielding is calculated for transceivers located in a limited area. The numerical value of the shielding effectiveness of a transmitter in dB is defined as the ratio of the power flux produced at a given point in space when the entire transmitter output is radiated through an omnidirectional antenna to the power flux at the same point due to spurious radiation when the transmitter is loaded by the shielded equivalent of the antenna. This index can be quantitatively determined from known values of maximum transmitter power in the pertinent frequency band, the distance to the transmitter and the field strength due to shielding inadequacy at the reception point. A formula for shielding effectiveness is derived for practical use. The effect that spurious radiation of the transmitter has on the receiver is considered, and an expression is derived for shielding effectiveness when receiver and transmitter are in close proximity. Recommendations are made on steps to avoid interference when making field strength measurements. References: 6 Russian.

USSR

SERIES K122 MICROCIRCUITS IN A SHORTWAVE TRANSCEIVER

Moscow RADIO in Russian No 12, 1978 pp 21-22

FIRSOV, YE., UA3VAM, Murom

[Abstract] The author discusses the use of series K122 and K118 IC's in amateur communications equipment. Circuits are given showing the use of the K1US222 rf and i-f amplifier in a 500 kHz reference oscillator, the K1UT221 differential amplifier in a mixer, balanced detector and modulator, and also i-f, lf and SSB signal shapers in an amateur communications transceiver based entirely on IC's. The maximum low-frequency output voltage is 2 V with a load impedance of 8 ohms. Amplification of the receiver channel is at least 72 dB, and suppression of the carrier frequency is no worse than 52 dB. The output signal level is 0.4 V in SSB operation, and 0.2 V for CW. Figures 4.

USSR

DIGITAL MICROCIRCUITS IN AMATEUR EQUIPMENT

Moscow RADIO in Russian No 12, 1978 pp 19-20

KRYMSHANKHALOV, T., UA6XAC, Master of Sport, USSR, Nal-chik

[Abstract] The author describes the use of series K133 and K155 integrated circuits in amateur radio equipment: a phase shifter based on D flip-flops; a mixer based on a D flip-flop that is simpler than analog mixers, and which produces a difference-frequency signal at the output, regardless of the distribution of the input signals; a threshold detector based on such a mixer; an analog mixer based on a NAND gate which provides both sum and difference frequencies of two waveforms; a linear mixer suitable for constructing SSB detectors, modulators and converters; drivers for class B operation of the final stage in low-power telegraph transmitters; a frequency divider for a master oscillator and a transmitter. Figures 7.

USSR

UDC 621.315.592

INTERACTION OF A STRONG ELECTROMAGNETIC WAVE WITH A SEMICONDUCTOR

Leningrad FIZIKA I TEKHNIKA POLUPROVODNIKOV in Russian Vol 13, No 3, Mar 79  
pp 423-426 manuscript received 3 Jul 78

KAZARYAN, E.M., MELIKYAN, A.O. and MINASYAN, G.R., Yerevan Polytechnic  
Institute imeni K. Marx

[Abstract] The energy spectrum of a semiconductor in the field of a strong electromagnetic wave, with a quantum energy larger than the energy gap, is analyzed on the basis of the Schroedinger equation for an electron in a periodic lattice field and in an external electromagnetic field. The solution includes terms representing resonant transitions with the free mass of an electron and terms representing nonresonant transitions with the effective mass. Corrections to the wave functions are calculated, assuming a parabolic dispersion, and nonresonant interband transitions are found to contribute not less than intraband motion or transitions through intermediate bands. They can, furthermore, alter the physical properties of the semiconductor and must be taken into account. References: 5 Russian.

USSR

UDC 621.315.592

ELECTRICAL CHARACTERISTICS OF EPITAXIAL GaAs LAYERS DOPED WITH SILICON

Leningrad FIZIKA I TEKHNIKA POLUPROVODNIKOV in Russian Vol 13, No 3, Mar 79 pp 553-557 manuscript received 15 May 78; in final editing, 20 Sep 78

MIL'VIDSKIY, M.G. and SOLOV'YEVA, YE.V., State Scientific Research and Planning Institute of the Rare Metals Industry, Moscow

[Abstract] A mass-spectrographic analysis was made of epitaxial GaAs layers produced from the liquid phase with forced cooling and then doped with silicon. The latter always was found to be accompanied by oxygen. The concentration profile and the energy spectrum of ionized centers, namely donors and acceptors in quenched layers and in annealed layers, were determined from the temperature dependence of the Hall effect during layer-wise etching. According to the results of measurements, quenched layers contain a  $\sim 0.02$  eV acceptor and annealed ones contain a  $\sim 0.1$  eV acceptor. Compensation in epitaxial GaAs layers grown at sufficiently low temperatures with quenching is effected by the  $\sim 0.02$  eV acceptor only at a low concentration of silicon and oxygen, according to the theory of amphotericism.

In other layers interaction between silicon and oxygen occurs during cooling, with the participation of arsenic diffusing from the substrate and forming 0.1 eV centers. Figures 4; references 10: 4 Russian, 6 Western.

USSR

UDC 621.315.592

# EFFECT OF TRAPS ON THE SPEED OF SEMICONDUCTOR-TYPE NUCLEAR RADIATION DETECTORS

Leningrad FIZIKA I TEKHNIKA POLUPROVODNIKOV in Russian Vol 13, No 3, Mar 79 pp 570-573 manuscript received 23 May 78; in final editing, 11 Oct 78

YEVDOKIMOV, V.M., ZAKHARCHUK, O.V., ROMANYUK, O.A., BORISOVA, N.A. and FEDOSEYEVA, O.P.

[Abstract] Semiconductor-type nuclear radiation detectors must feature not only a high energy resolution but also a high speed. Here the effect of traps, always present in the material, on the time characteristics of these devices is determined on the basis of an approximate mathematical model not taking into account the nonuniform distribution of the electric field over the sensitivity zone. The current pulse and the charge pulse are calculated by integrating the concentration of excess electrons in the conduction band over the width of the sensitivity zone and over time. This concentration, as a function of time, is found by solving a system of two differential equations for its rate of change and that of the concentration of electrons on traps. Instead of a numerical evaluation, an approximate analytical evaluation is made for periods of time respectively shorter or longer than the electron transit time. According to the results, the presence of traps causes the duration of a current pulse and the risetime of a charge pulse to become longer. Both effects are undesirable. The theoretical results agree closely with experimental data, except after the concentration of traps. Figures 2; references 2: 1 Russian, 1 Western.

USSR

UDC 621.315.592:537.312.7

ANISOTROPIC PROPERTIES OF SEMICONDUCTORS IN A STATIC ELECTRIC FIELD AND IN A MICROWAVE ELECTROMAGNETIC FIELD

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24, No 3, Mar 79 pp 647-649 manuscript received 9 Feb 77

USANOV, D.A. MOROZOV, V.A. (deceased), PAKHOMOV, V.V. and BURENIN, P.V.

[Abstract] Semiconductors have found many applications in nonreciprocal microwave devices such as waveguides. While their anisotropy at microwave frequencies caused by an applied magnetic field is well known, that caused by an applied electric field is not. In an analysis of the latter situation an electric field of constant intensity is applied to an n-type semiconductor which either completely or partially fills a rectangular waveguide through which an electromagnetic wave ( $TE_{mn}$  mode) propagates in the direction of this field. The propagation constant is calculated from the equation of motion for electrons, involving the complex electrical conductivity and the complex dielectric permittivity. The imaginary part of this propagation constant, is also a complex quantity, and thus the attenuation changes identically whether the direction of wave propagation or the direction of electric current is reversed with the other remaining the same. This non-reciprocity of wave propagation caused by current passage through the semiconductor in a parallel direction has been demonstrated both theoretically and experimentally with n-InSb specimens at 36 GHz. Figures 1; references: 2 Russian.

USSR

UDC 621.315.592:546.681.19

EFFECT OF IONIZED IMPURITIES ON MEASUREMENT OF VELOCITY-FIELD CHARACTERISTICS IN GALLIUM ARSENIDE BY THE MICROWAVE METHOD

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 25, No 3, Mar 79 pp 650-651 manuscript received 15 Apr 77

ARKUSHA, YU.V. and PROKHOROV, E.D.

[Abstract] Ionized impurities affect not only the static velocity-field characteristics in GaAs but also the field dependence of electron velocity in GaAs measured by the microwave method. This is demonstrated here by calculations on the basis of the two-level model with an alternating electric field  $E(t) = E_0 + E_1 \sin \omega t$  across a homogeneous GaAs specimen. First the Boltzmann kinetic equation is averaged with respect to electron concentration, energy and momentum. Then the dynamic  $v-E(t)$  characteristics at

various frequencies and electron (impurity) concentrations are reduced to measurable static v-E characteristics. Some sensitivity of microwave measurements to electron concentration (impurity presence) is found, but not as high as that of static measurements, and especially in the range of high electric field intensities beyond the velocity peak. This is explained by different modes of electron scattering and thus different lengths of time of subsequent electron energy and momentum relaxation at low and high concentrations respectively. Scattering by optical and acoustical phonons as well as intervalley scattering and scattering between equi-valence valleys, in addition to scattering by ionized impurities, is taken into account in the analysis. Figures 1; references 3: 1 Russian; 2 Western.

USSR

UDC 621.382.2

#### GALLIUM ARSENIDE DIODE TEMPERATURE SENSORS

MOSCOW PRIBORY I TEKHNIKA EKSPERIMENTA in Russian, No 1, Jan-Feb 1979, pp 256-257 manuscript received 23 Jun 77

IVANOV, L.P., KORENMAN, M.YE., LAKHTIKOVA, V.G. and PRIKHOD'KO, G.L.

[Abstract] Temperature sensors of GaAs with p-n junctions are investigated. They were produced in the temperature interval  $4.2 \div 373$  K: 1) By diffusion of Cd or Mg in n-type GaAs with  $n = 1 \cdot 10^{17} \text{ cm}^{-3}$ ; and 2) By diffusion of Sn in p-type GaAs with a concentration of current carriers of  $7 \cdot 10^{16} \text{ cm}^{-3}$ ,  $3 \cdot 10^{17} \text{ cm}^{-3}$  and  $3 \cdot 10^{19} \text{ cm}^{-3}$ . All the thermosensors were produced according to mesatechnology. Pb with Sn and Zn additives was used as ohmic contacts. The diode temperature sensors of n-type GaAs, produced by diffusion of Cd, have the best characteristics. In the temperature interval  $77 \div 373$  K, the thermometric characteristics for all types of temperature sensors are quasi-linear and have a steepness on the order of  $2 \div 2.5 \text{ mV/K}$ . The reproducibility of the diode response is not worse than  $0.3 \text{ mV}$ , and the voltage fluctuations at  $77 \text{ K}$  do not exceed  $10 \text{ microV}$ . It is possible to increase the steepness of the thermometric characteristics in the region of Helium temperatures by using temperature sensors of hole-type GaAs. Graphs are shown of the thermometric characteristics of n-type GaAs diodes with diffusion of Cd, Hg and Zn; and of p-type GaAs with various concentrations of holes in the base. Figures 2; tables 1; references: 2 Russian.

## GUNN EFFECT IN A STRONG TRANSVERSE MAGNETIC FIELD

Leningrad FIZIKA I TEKHNIKA POLUPROVODNIKOV in Russian Vol 13, No 3, Mar 79 pp 563-569 manuscript received 7 Jun 78; in final editing, 28 Sep 78

CORFINKEL', V.B., LEVINSHTEYN, M.YE. and MASHOVETS, D.V., Physico-Technical Institute imeni A.F. Ioffe, USSR Academy of Sciences, Leningrad

[Abstract] The current-voltage characteristics of short ( $l/d \approx 1$ ) GaAs Gunn-effect diodes at room temperature (300 K) were measured in a transverse pulse magnetic field up to 10 T strong. Epitaxial GaAs films, 10-15  $\mu\text{m}$  thick with an electron concentration of  $8 \cdot 10^{14}$ - $2 \cdot 10^{15} \text{ cm}^{-3}$  and an electron mobility of 0.55-0.65  $\text{m}^2/\text{V}\cdot\text{s}$ , had been deposited on semiconductor substrates. The contact tabs were  $d \approx 300$ -1000  $\mu\text{m}$  wide and  $L \approx 70$ -100  $\mu\text{m}$  apart. The results agree closely with calculations by the Monte Carlo method and disprove the phenomenological prediction (based on earlier measurements at 77 K in a transverse constant magnetic field up to 3 T strong) that in sufficiently strong magnetic fields the dependence of the mean electron drift velocity on the electric field intensity changes from an N function to an S-N function. In fact, at 300 K the influence of a magnetic field is much weaker. As the magnetic induction  $B$  increases proportionally to  $B^2$ , then tends to level off over the 2.5-4.5 T range, and beyond that again increases proportionally to  $B^2$  but at a much slower rate. The negative differential electrical conductivity, moreover, vanishes at 300 K as the magnetic induction exceeds 2.5 T. The authors thank V.L. Gel'mont for many helpful comments. Figures 4; references 18: 4 Russian, 14 Western.

## TWO MODES OF BEHAVIOR OF EXCESS CARRIERS IN P-N HETEROJUNCTIONS AT HIGH CURRENT DENSITIES

Leningrad FIZIKA I TEKHNIKA POLUPROVODNIKOV in Russian Vol 13, No 3, Mar 79 pp 617-619 manuscript received 1 Sep 78

GRIBNIKOV, Z.S. and MEL'NIKOVA, YU.S., Institute of Semiconductors, Ukrainian Academy Sciences, Kiev

[Abstract] It is demonstrated by theoretical analysis that at a high direct current the behavior of current carriers in sharp nondegenerate p-n heterojunctions with discontinuities in the band structure, which still allows reciprocal injection of electrons into the p-region and of holes into the

n-region, will depend on the ratio of the carrier mobilities in both regions respectively. Bilateral diffusion occurs, limited by either emission at contact tabs or by space charge only, when the ratio of electron mobility-to-hole mobility is higher in the n-region than in the p-region. Bilateral drift occurs, following saturation of carrier concentrations in both regions, when this ratio is lower in the n-region than in the p-region. Both modes of behavior can also be deduced from the general expressions for electron current and hole current densities, with the boundary conditions of a quasi-equilibrium carrier distribution near the heterojunction and negligible recombination at the highly defective heterojunction surface. This procedure also yields the upper limit for the ratio of the n-region mobility ratio to the p-region mobility ratio and thus the maximum concentrations of both types of carriers. The analysis applies, in principle, to p-n homojunctions as well. References: 3 Russian.

USSR

UDC 621.382.233.011.222.072

#### FEASIBILITY OF FASTER TURN-OFF OF POWER THYRISTORS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24, No 3, Mar 79 pp 606-614 manuscript received 19 Jan 77

GREKHOV, I. V., GORBATYUJ, A.V. and KOSTINA, L.S.

[Abstract] The turn-off process in a thyristor following a reversal of the applied voltage is analyzed on the basis of a physical model of a p-n-p-n structure with a moderately doped p-base. Recovery of the low-voltage emitter and resorption of excess charge of the narrow p-base are disregarded, but non-linearity of injection at the collector is taken into account in terms of the Fletcher boundary condition, while the injection level is assumed to be low in the p-base and high in the n-base. The concentration distribution of excess charge in the n-base is calculated, as a function of time, as a superposition of two solutions to the diffusion equation for n-base charge carriers: first with both the collector current and the p-emitter current having only hole components, second with the collector current having only an electron component. Subsequently the time constant of charge resorption, equal to the turn-off time, is calculated as a function of the p-base width at a constant concentration of excess charge. The trend of these relations indicates that the turn-off time can be significantly shortened through depletion of the p-base by the electron component of the collector current. This requires that the  $n^+$ -p-n transistor operate as an active device after the anode current has dropped sharply during the third stage of the process, and can be achieved by a more effective shunting of the  $n^+$ -p emitter. Figures 3; tables 1; references 11: 9 Russian; 1 Western.

## Electrical Engineering Equipment and Machinery

USSR

UDC 538.122

## INVESTIGATION OF THE INFLUENCE THAT THE FORM OF BOUNDARY CONDITIONS HAS ON CONVERGENCE IN NUMERICAL CALCULATION OF A THREE-DIMENSIONAL MAGNETIC FIELD BY THE NET-POINT METHOD

Novocherkassk IZV. VUZ: ELECTROMEKHANIKA in Russian No 12, Dec 78  
pp 1281-1290 manuscript received 18 Jun 77, after completion, 7 Feb 78

ALEKSIDZE, MERAB ALEKSANDROVICH, dr of physical-mathematical sciences, professor, department head. PERTAYA, KONSTANTIN VIKTOROVICH, candidate in technical sciences, senior science worker, Computing Center, Georgian Academy of Sciences; and POPOV, VIKTOR VASIL'YEVICH, candidate in technical sciences, docent, Leningrad Polytechnical Institute

[Abstract] A study is done of the way in which the convergence and stability of numerical calculation of a three-dimensional electromagnetic field by the net-point method are influenced by the choice of boundary conditions for the components of the vector potential in the interface between media with different permeabilities: generally accepted conditions that establish the relation between different components of the vector potential, and split conditions that establish the relation only between like components of the vector potential. The analysis is based on an example of the magnetic field of the armature of a turbogenerator in synchronous steady-state operation. It is shown that split boundary conditions ensure stable convergence of the solution, while the process of solution is divergent for the generally accepted boundary conditions when conventional iteration methods are used. A method is proposed that ensures stable convergence for generally accepted boundary conditions. Figures 1; 9 Russian.

USSR

UDC [538.521.3:621.3.015.11].001

# MATCHING AN INDUCTIVE ACCUMULATOR AND A COIL TO A LINER WITH LIMITATION ON THE BREAK VOLTAGE

Moscow IZVESTIYA AKADEMII NAUK SSSR, ENERGETIKA I TRANSPORT in Russian, No 6, Nov-Dec 78 pp 9-14 manuscript received 22 Nov 77; after revision, 25 Apr 78

ZOTOVA, E.A., IVANOV, I.A., LOTOTSKIY, A.P. and TRUKHIN, V.A., Moscow

[Abstract] In order to match an inductive accumulator to a liner startup system, it is necessary to take into account the limitation imposed on the maximum discharge pulse voltage by the electric strength of the circuit breaking switches. Here an accumulator consisting of N identical segments is considered, on the assumption of negligible leakage of magnetic flux in the discharge circuit during startup of a long and thin-walled cylindrical liner by a longitudinal magnetic field. The liner startup time is assumed to be much shorter than the diffusion time toward the end of the charging cycle. Faraday's law of induction, in terms of the rate of change of current, is transformed to a quadratic algebraic equation and from the solution to the latter power and efficiency relations for the system are derived. The results indicate the best matching and design parameters, as well as the performance under mismatch. Tables 1; references: 4 Russian.

USSR

UDC [546.68:621.3.047] 001.24

# DESIGN ANALYSIS OF LIQUID-METAL SLIP RINGS

Moscow IZVESTIYA AKADEMII NAUK SSSR, ENERGETIKA I TRANSPORT in Russian, No 6, Nov-Dec 78 pp 156-158 manuscript received 23 Jan 78

GLAZKOV, YU.P., IVANOV-SMOLENSKIY, A.V. and PEREL'SHTEYN, G.N., Svredlovsk and Moscow

[Abstract] One basic problem in the design of liquid-metal slip rings is matching the materials in contact, namely the fusible alloy with the material of stationary and movable electrodes. Results of research already done at the Institute of Thermophysics (Siberian Division of the USSR Academy of Sciences) and at the Ural Heavy Electrical Machinery Plant indicate that electrodes made of 1Kh18N10T stainless steel or copper are compatible with a sodium-potassium alloy, based on a life of 1500 h and 835 h respectively. Here the hydrodynamic losses are calculated so as to establish a better correlation between theory and experiment. These

calculations are based on dimensional analysis of experimental data for stainless steel with a gallium-indium alloy (77.6 percent Ga + 22.4 percent In), using water as the reference liquid. The power loss is referred to the density and the kinematic viscosity of the liquid, to the radius of the slip ring, to the contact area and to the speed squared. This referred power loss is proportional to some fractional power of the Reynolds number with different exponents and different coefficients for a rotating inner and a rotating outer slip ring. The differences in speed caused by differences in construction (rotating inner or outer slip ring) and by characterizing the choice of materials for the contact pair become significant only when the Reynolds number is above  $(1-6) \cdot 10^7$ . Figures 1; tables 1; references 7: 6 Russian, 1 Western.

USSR

UDC 62-784.62:621.3.013.13.001.2

#### SHIELDING OF A ROTATING ELECTROMAGNETIC FIELD WITH A MULTILAYER CYLINDRICAL SHELL

Moscow IZVESTIYA AKADEMII NAUK SSSR, ENERGETIKA I TRANSPORT in Russian, No 6, Nov-Dec 78 pp 91-98 manuscript received 13 Jun 77

IVANOV, S.A., Leningrad

[Abstract] Design formulas are derived for the shielding factor and the reflection coefficient in devices with retention of the electromagnetic field by shields made generally of a conducting ferromagnetic material. They are based on recurrence relations for an arbitrary number of infinitely long coaxial cylindrical shells separated by dielectric layers. The shield material is assumed to be isotropic with uniform electrical conductivity and magnetic permeability. The array of currents flowing in the nonmagnetic cylindrical layer of space outside such a multilayer shield, with the distribution of current density here consisting of a fundamental component and space harmonics rotating relative to the shield, generates a rotating electromagnetic field. This current sheet is assumed to be surrounded by a ferromagnetic core with an infinitely high permeability. A double-layer shield and a triple-layer shield are considered within the frequency range where eddy currents and displacement currents remain negligible. On this basis, a simple algorithm is developed for practical engineering calculations and shield design. Figures 3; references 9: 7 Russian, 1 German, 1 Western.

**SPECIAL FEATURES OF THYRISTOR EXCITATION OF TVV-800-2 TURBOGENERATOR WITH A SUT-V4 CONTROL SYSTEM**

Moscow ELEKTRICHESKIYE STANTSIIYE in Russian No 11, 1978 pp 39-43

LIBER, A. B., SHISHKANOV, S. G. and KARDASHEV, S. A., engineers, SAVCHENKO, YE. V., candidate of technical sciences, and MAKAROV, A. P., engineer, Elektroyuzhmontazh-Donbassenergo-LPEO Elektrosila

[Abstract] The control system of SUT-V4 thyristor converters was developed by UNIIEM (All-Union Scientific-Research Institute of Electrical Machines) and introduced into a number of electrical stations in the USSR and abroad. Plant-assembled, the unit was adapted for direct use in the excitation circuit with single-cabinet thyristor converters. When the control system was applied to the STN-670-4200 excitation system with three-cabinet converters, the individual SUT-V4 units required circuitry and design revisions. In place of the ARV-SD integrated automatic regulator in the excitation system of an auxiliary generator, a simplified nonlinear bridge-based governor is advisable. This governor provides for all the necessary automatic modes of the auxiliary generator with adequate efficiency. To improve the operating conditions of the control system when there are possible operating drops in turbine generator rpm, it is best to modify the amplitude- and phase-frequency characteristics of the filter blocks. Synchronizing the control pulses in the like control channels of three parallel-connected thyristor converters of the main generator is an effective means of control of the converter load and ensures virtually symmetrical performance of the converters in static conditions. The adequacy of these measures must be checked with additional dynamic analysis of the control conditions in excitation forcing experiments. For prevention of the flow of large equalizing currents in the modes of transition of a generator from 2 thyristor exciter to machine excitation and vice versa, a closure circuit is made for the thyristor converter for the parallel connection time of exciters.

USSR

UDC 621.314

#### A TWO-TRANSFORMER VOLTAGE BOOSTER WITH THYRISTORS IN THE MAGNETIZING CIRCUIT

Minsk IZV. VUZ, ENERGETIKA in Russian, No 3, Mar 79 pp 29-34 manuscript received 21 Dec 78

PAVLOV, I.F., candidate in technical sciences, and NAGUL, V.I., engineer, Vinnitsa Polytechnical Institute

[Abstract] A two-transformer reversible voltage booster is proposed with thyristor control in the primary circuits. The magnetizing primary windings of both transformers are connected in series aiding, while their boosting secondary windings are connected in series opposing. The primary windings are, furthermore, shunted by simistors. Voltages and currents are calculated according to Kirchhoff's laws for the equivalent circuit, also phasor diagrams are constructed for three points of operation, assuming negligible winding impedances. The performance of this device as a voltage stabilizer or smooth voltage regulator under load has been proved experimentally, with the aid of an oscillograms which reveal the harmonic content under various load levels. The overall performance compares favorably with that of a single-transformer voltage booster. The paper was submitted by the Department (Kafedra) of Power Engineers, Vinnitsa Polytechnical Institute. Figures 4; tables 1; references: 2 Russian.

USSR

UDC 621.315.1

#### CALCULATION OF ELECTRODYNAMIC FORCES IN COAXIAL COILS OF RECTANGULAR SHAPE

Minsk IZV. VUZ, ENERGETIKA in Russian, No 3, Mar 79 pp 3-8 manuscript received 8 Sep 77

PAVLOVETS, V.V., engineer, Order of Labor's Red Banner Belorussian Polytechnical Institute

[Abstract] A method is proposed for calculating the electrodynamic forces in coaxial coils wound with rectangular turns. The current density is assumed to be uniform over the conductor cross section and the effect of ferromagnetism is disregarded. The gist of the method is determining the force between two arbitrarily located infinitesimally thin straight conductors and then correcting with a form factor expressed as a third-degree polynomial function of three winding parameters. The integral in the expression for the force is converted to a sum of two series, according to the method of segments. A "least squares" algorithm of these calculations has been constructed for use on a Minsk-32 computer. The paper was submitted

by the Department (Kafedra) of Electric Power Stations, Belorussian Polytechnical Institute. Figures 4; references 4: 3 Russian, 1 Western.

USSR

UDC 621.315.624

**SMOOTHING THE VOLTAGE DISTRIBUTION ALONG AN INSULATOR STRUCTURE BY MEANS OF A SHIELD**

Minsk IZV. VUZ, ENERGETIKA in Russian, No 3, Mar 79 pp 23-29 manuscript received 20 Jun 78

SERGEYEV, A.S., engineer, Order of Lenin Leningrad Polytechnic Institute imeni M.I. Kalinin

[Abstract] The effect of a toroidal shield around a high-voltage apparatus on the voltage distribution along the insulator structure is examined, such a structure also including nonlinear overvoltage limiters and voltage dividers. The design and the performance of such shields are analyzed by varying their number and their geometrical dimensions. A single toroidal shield is found to be inadequate for smoothing the nonuniform voltage distribution along the insulator structure, the result of a nonuniform electric field distribution between the high-voltage terminal and the ground. A double shield is found to be very effective, especially with the lower shield having a large radius and mounted far below the upper smaller one. A multitoroidal shield is found to be most effective. The paper was submitted by the Department (Kafedra) of Electrical Apparatus, Leningrad Polytechnical Institute. Figures 4; references 7: 6 Russian, 1 German.

**INVESTIGATION OF THE STABILITY OF A MAGNETIC SUSPENSION FOR A BODY WITH A FERROMAGNETIC DISK**

Novocherkassk IZV. VUZ: ELEKTROMEKHANIKA in Russian No 12, Dec 78 pp 1300-1305

VOROB'YEV-OBUKHOV, ALEKSEY VADIMOVICH, junior science worker, Scientific Research Institute of Applied Mathematics and Cybernetics at Gor'kiy University

[Abstract] An investigation is made of the stability of magnetic suspension of a body securely fastened to a ferromagnetic armature in the form of a flat disk suspended by four electromagnets. Such a suspension requires stability control both with respect to the vertical and with respect to angles of inclination about the horizontal axes. In order to provide a stable state of equilibrium, the automatic control system must control all degrees of freedom except rotation about the vertical axis of symmetry. The system used for this purpose changes the magnitude of the sum of the currents in the electromagnets depending on the position of the body with respect to the vertical, and the magnitudes of the difference in currents in opposite magnets depending on the angles of inclination and transverse displacements of the body. It is shown that such a suspension has the property of automatic leveling of the suspended body, while the amount of transverse shifting is determined by the sensitivity of the automatic control system to angular and linear displacements of the disk in the horizontal plane. These suspensions can be used for vibration insulation of instruments in the case of comparatively low-frequency horizontal oscillations of the base, and for automatic leveling in the case of slow angular deflections of the base. Figures 3; references: 4 Russian.

## OPTIMIZING THE PARAMETERS OF SUSPENSION ELECTROMAGNETS

Novocherkassk IZU. VUZ: ELEKTROMEKHANIKA in Russian No 12, Dec 78  
pp 1306-1310 manuscript received 10 Jun 77

LOBOV, VORIS NIKOLAYEVICH, graduate student; NIKITENKO, ALEKSANDR GRIGOR'YEVICH, candidate in technical sciences, docent, prorector; GRINCHENKOV, VALERIY PETROVICH, candidate in technical sciences, senior instructor; and PALIY, VALDINIR YAKOVLEVICH, candidate in technical sciences, docent, all from Novocherkassk Polytechnical Institute

[Abstract] An analysis is made of the geometric proportions and selection of optimum parameters of the magnets for an electromagnetic levitation system in high-speed surface transport. The suspension is made up of a U-shaped electromagnet and a flat magnetic rail. This analysis includes investigation of the influence that the principal parameters of the magnet system have on the power consumption of the electromagnet, its mass, and the time constant of the winding, which determines the technical efficiency of control of the moving vehicle as well as the economic feasibility of the electromagnet system. Criterion functionals are formulated for these three parameters in terms of the geometric dimensions of the electromagnet with constraints on lift and on the magnetic induction of the magnetic circuit material. These expressions were minimized on a Mir digital computer for lift values in a range of 500-50,000 N with a gap of 2 cm between magnet and rail, taking the magnetic induction as 1.6 T. A complex criterion is proposed for compromising the conflicting requirements of minimizing mass (power) and the time constant of the winding. A table is given summarizing the results of calculation of the parameters of electromagnets that have minimum values of the proposed criterion. Figures 6; tables 1; references 6: 5 Russian; 1 Western.

## INVESTIGATION OF A SYSTEM FOR STABILIZING THE SUSPENSION OF A SHAFT ON TWO ELECTROMAGNETIC BEARINGS

Novocherkassk IZV. VUZ: ELEKTROMEKHANIKA in Russian No 12, Dec 78 pp 1311-1317 manuscript received 9 Dec 77

VASIL'YEV, VLADIMIR SERGEYEVICH, engineer; and SERDYUK, GAY BORISOVICH, candidate in technical sciences, docent, Kiev Polytechnical Institute

[Abstract] An analysis is made of a system for stabilizing the suspension of a shaft on two controllable electromagnetic bearings. It is assumed that the system is typical of two-dimensional radial magnetodynamic suspensions. In the absence of axial perturbations, the shaft is maintained in the necessary position by the centering action of the force fields of the radial magnetic bearings. Axial stabilization can be provided by permanent magnets or by an auxiliary uniaxial magnetodynamic suspension. The analysis of the stabilization control system is restricted to regulation of the shaft position in one plane because regulation in the mutually perpendicular plane is independent. The equation of motion is derived from examination of the general case of asymmetric suspension of the shaft in a viscous fluid. It is shown that the suspension stabilization system in each plane is a two-channel control system with symmetric cross feedback and external negative feedback. The transfer function and characteristic equation of the stabilization system are derived. The resultant analytical expressions can be used for engineering calculations in determining fundamental static and dynamic characteristics and stability conditions. The validity of the initial assumptions is verified by experimental determination of the amplitude-frequency curve for a specific system. Figures 4; references: 6 Russian.

USSR

UDC 621.327.534.15.032.4

OPTIMIZATION OF FREQUENCY AND SUPPLY VOLTAGE OF GAS-DISCHARGE LIGHT SOURCES

Minsk IZV.VUZ:ENERGETIKA in Russian, No 1, Jan 79, pp 119-121 manuscript received 29 May 78

BAZHENOV, I.A., candidate in technical sciences, docent; KOSTERIN, S.G., LEBEDEV, YU. V. and YAKIMOV, V.P., students

[Abstract] The paper is concerned with optimization of the supply parameters of gas-discharge light sources by means of finding the minimum specific consumption of electrical energy per unit of luminous flux. With the representation of a gas-discharge light in the form of an electroluminescent capacitor, the optimum frequency is found in the  $400 \div 450$  Hz range with a voltage of  $240 \div 250$  volts. In this frequency range it is advisable to use a static ferromagnetic frequency multiplier for supply of the gas-discharge light source. The paper was presented by the Department (Kafedra) of Electrical Stations, Ivanovskiy Power Engineering Institute imeni V.I. Lening. Figures 2; references: 5 Russian.

USSR

UDC 621.311.4:621.316.932

RELIABILITY OF LIGHTNING PROTECTION IN 35 kV AND 110 kV SUBSTATIONS

MOSCOW IZVESTIYA AKADEMII NAUK SSSR, ENERGETIKA I TRANSPORT in Russian, No 6, Nov-Dec 78 pp 74-80 manuscript received 21 Jun 78

ALIYEV, F.G., ISKAKOV, I.I., KOSTENKO, M.V. and KHALILOV, F.KH., Sverdlovsk and Leningrad

[Abstract] The lightning protection for 35 kV and 110 kV distribution substations is analyzed on the basis of calculations according to the conventional Leningrad Polytechnic Institute method and according to a more precise method, also on the basis of empirical data covering ten locations throughout the Soviet Union over the 1955-75 period (13,522 substation-years in 35 kV networks and 8080 substation-years in 110 kV networks). The empirical data include statistical characteristics of lightning duration and intensity as well as failure rates. The confidence interval for the reliability index of transformers and appurtenances, namely the reciprocal of their expected yearly failure rate is evaluated assuming a Poisson distribution of insulation failure. The probable number of dangerous voltage surges is calculated as the sum of not only surges on the phase conductors upon approach and return to the danger zone but also surges on the electrical equipment during approach and return to the substation territory past the lightning arresters. The calculations have been programmed on a MIR-2 computer. The results of these calculations of the reliability index are very conservative for 35 kV substations (250 years compared with 590 years on the basis of service experience) and close for 110 kV substations (555 years compared with 580 years on the basis of service experience). Accordingly, modern normal lightning protection is found to be adequate. However, the Leningrad Polytechnic Institute of reliability analysis is not valid in this case. Figures 3; tables 2; references 10: 9 Russian, 1 Western.

**TECHNICAL-ECONOMIC COMPARISON OF CONFIGURATIONS OF SUPPORTING INSULATOR CHAINS ON 750 kV Lines**

Moscow ELEKTRICHESKIYE STANTSIIYE in Russian No 11, 1978 pp 61-65

FATEYEVA, I. V., engineering, SHERENTSI, A. N., candidate in technical sciences; and YASINSKAYA, N. V., engineer, VNIIE All-Union Scientific-Research Institute of Electric Power Engineering.

[Abstract] Single insulator chains on 750 kV lines are shown to have marked technical-economic advantages over double insulator chains by calculations related to expansion of 750 kV power grids. This conclusion is based on the fairly low probability of coincidence of the tripping out of a chain with the conditions of transmitting maximum power over a 750 kV line. Placing the chains on standby status in the regimes of daytime decrease in load, summer regimes, and other similar conditions is also economically unjustified even without allowing for the presence of reserves that are always present in the power system in these periods. The probability of tripping out of a chain in a section of the 750 kV line is one order of magnitude smaller than the probability of protracted deenergizing of the 750 kV line section, accompanied by losses because of the undersupply of electric energy which placing chains on standby status cannot prevent. Superhigh-voltage transmission lines can only be made more reliable by raising the quality of insulators built to world standards. A V-type suspension in the middle phase of a 750 kV line increases the cost of 750 kV line insulator chains by 20-25 percent. However, in several cases technical-economic advantages can be secured that are much greater than the added capital investments in line insulation. Figures 3; tables 4; references: 9 Russian.

USSR

UDC 621.315.3:621.3.013

TO THE PROBLEM OF THE EXTERNAL FIELDS OF BALANCED MULTIAMPERE CONDUCTORS

Minsk IZV.VUZ:ENERGETIKA in Russian, No 1, Jan 79, pp 20-25 manuscript received 27 Dec 77

AZOVTSSEV, A.A., LAZAREVSKIY, N.A., TSITSIKYAN, G.N., candidates in technical sciences, and ERIN, V.N., engineer. Central Scientific-Research Institute of Ship Electrical Engineering and Technology (Leningrad)

[Abstract] Quantitative estimates are obtained for the reduction of intensity of the field for a balanced conductor with two parallel branches, one of which is turned 180 spatial degrees with respect to the other.

A comparative estimate is given by the ratios  $3c$  and  $2c$  respectively with  $L \leq 1$  and  $L \geq 1$ . The paper was presented by the Department (Kafedra) of General Electrical Engineering, Leningrad Polytechnical Institute.

Figures 2; references 8: 3 Russian; 5 Western.

## CHARACTERISTICS OF TOTAL CORONA ON CONDUCTORS OF COMBINED OVERHEAD LINE

Minsk ISV.VUZ:ENERGETIKA in Russian, No 1, Jan 79, pp 37-41 manuscript received 14 Dec 77

KADONSKAYA, K.P., dr in technical sciences, Professor; PYATKOV, A.V., engineer; and KHAKIMOV, F.Z., candidate in technical sciences. Novosibirsk Institute of Electrical Engineering. Siberian Scientific-Research Institute of Power Engineering.

[Abstract] To a considerable degree the cost of construction of an overhead line and the economy of its exploitation are determined by the phenomenon of corona discharge on the wires of these lines. The present paper studies such coronas and derives the required characteristics by experimental investigations and by calculations. A double circuit combination overhead line, consisting of two circuits of different classes of voltage arranged one below the other, with the lower voltage circuit located under the higher voltage circuit, served as a transmission which possesses an increased capacity and which makes it possible to decrease the value of the electrical field intensity to a magnitude on the order of 5--10 kV/m. Because the numerical calculations of the transient processes of a corona discharge were performed in conformity with electrotransmissions of ultrahigh voltage, use of the expressions cited in the paper for equivalent characteristics of the corona are permissible with a voltage of the upper circuit with the voltage equal to or exceeding 500 KV and for the lower, 220 KV. Investigations show that during modeling of the characteristics of the corona on the wires of a combined overhead line with the aid of gate (ventil'nyy) models for each of the six phases of a combined overhead line, using as the initial parameters for a model of the corona, parameters obtained according to expressions derived in the work. Figures 3; tables 1; references; 4 Russian.

CSO: 1860

- END -

**END OF**

**FICHE**

**DATE FILMED**

2 Aug 1979

22.